SCIENTIFIC AMERICAN

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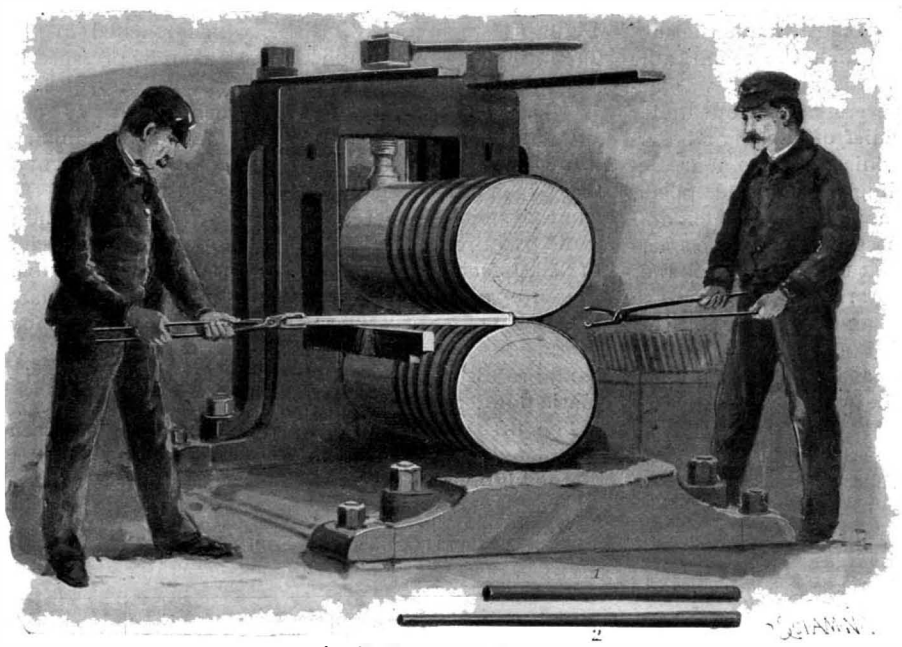
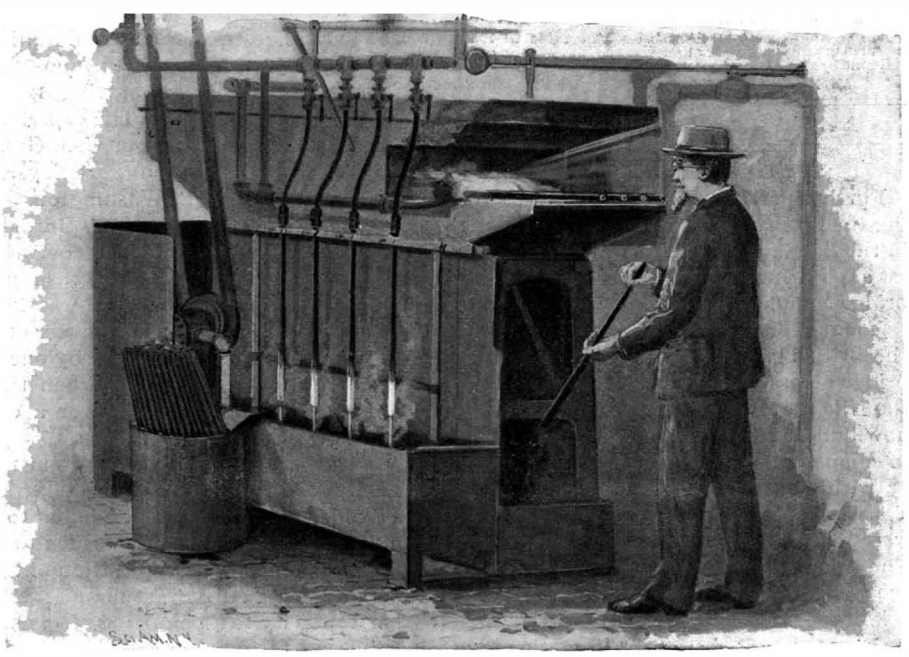
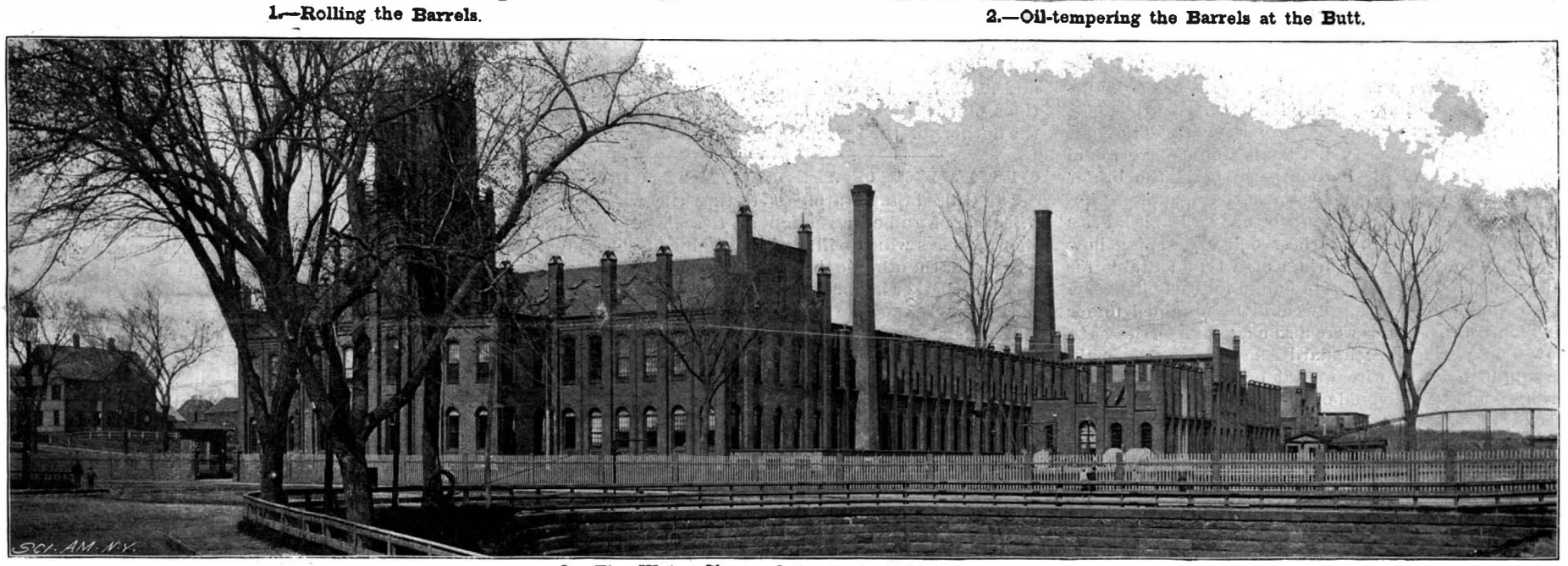


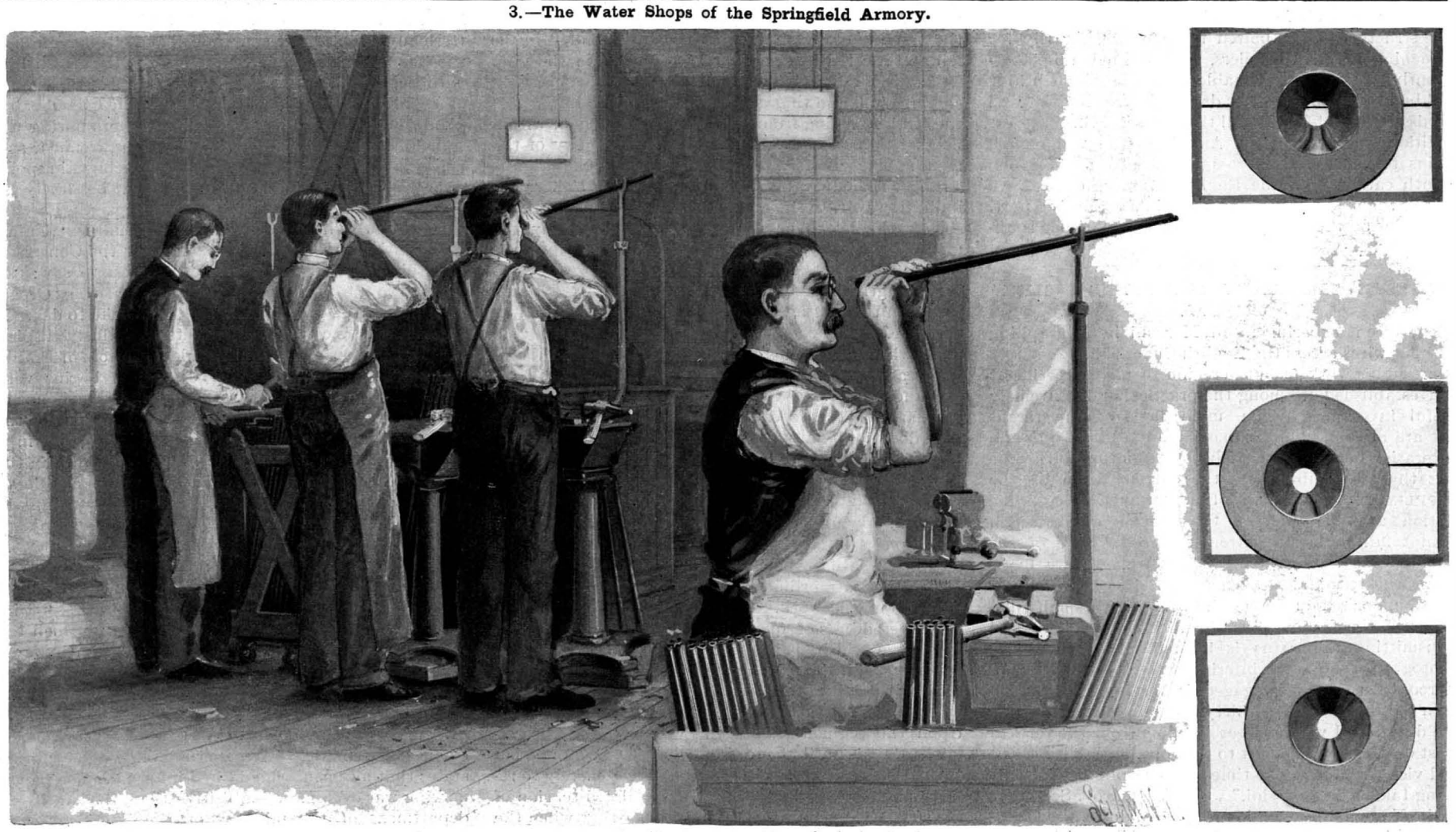
1.—Rolling the Barrels.



2.—Oil-tempering the Barrels at the Butt.



3.—The Water Shops of the Springfield Armory.



4.—Straightening Barrels.

I.—MANUFACTURE OF KRAG-JORGENSEN RIFLES AT THE SPRINGFIELD ARMORY.—[See page 267.]

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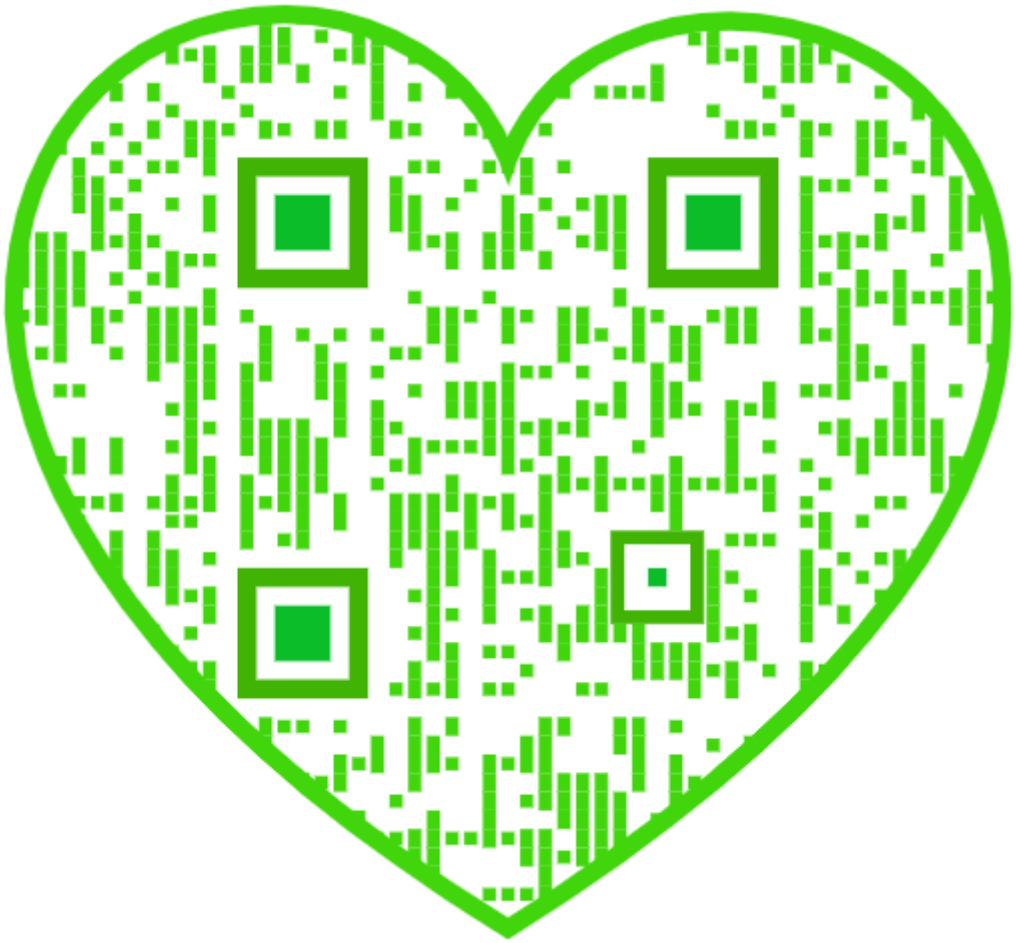

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THAT ATHBARA BRIDGE CONTRACT.

Further particulars that have come to hand regarding the letting of the contract for the Athbara bridge in the Soudan to an American firm, are of great interest as showing the rapidity and cheap cost at which our bridge companies can undertake to lay down material, as compared with foreign competitors. Late last year the British government decided to complete a railroad bridge across the Athbara River, a large tributary of the Nile that is intercepted by the military railroad now building through the Soudan. It was determined to complete the bridge before the floods of July, 1899, or within a period of six or eight months. The designs and specifications were drawn in London and bids were solicited from both British and American firms. The American bids varied from $52 to $65 per ton and the time of delivery was in each case two months and a half, while the lowest British bid was $68 per ton and the highest $80.50 per ton, the time of delivery varying between three and a quarter months and six months.

When the design and the bids were received in Egypt on December 28, it was discovered that the bridge, as designed, did not admit of being launched from the piers, but would have to be erected on false work. The character of the river was such that it would have taken two years instead of six months to build the bridge upon false work. As time was a matter of supreme importance, a telegram was sent to the two English firms that had promised the earliest delivery, asking how soon they could supply a bridge of a type suitable for launching, and promising a premium for early delivery. It was found that no supply could be obtained under six months. Inquiries were also made in America as to how soon a bridge of standard American design could be supplied, and a wire was at once received that a bridge could be delivered on board at New York in six weeks.

A contract was signed on January 30 of this year; the seven spans were completed in thirty-seven days, or five days earlier than the contract date of March 8, and the complete bridge was on its way to Liverpool by March 15. It was due at Alexandria about April 15, and it is expected that it will reach the site by May 15, or a few days before the piers have been completed. The structure will be bolted together temporarily for launching across the piers, and riveted up subsequently. It is now probable that the whole bridge will be in place by the first day of July, when the Nile floods are expected. It will thus be seen that the expeditious methods of the American firm will enable trains to be running across the Athbara River one month earlier than the English builders could have placed the material on board ship in an English port. Comment on these very remarkable comparisons is unnecessary.

WIRELESS TELEGRAPHY ACROSS THE ENGLISH CHANNEL.

The recent experiments of Marconi in telegraphing without wires across the English Channel have entirely removed his work from the region of mere experiment and established it among the practical and extremely useful inventions. The main facts of the recent test are already familiar to our readers and require no reiteration here, but we wish to draw attention to the fact that we publish in the current issue of the SUPPLEMENT illustrations of the terminal telegraphic station at Wimereux, on the French coast, which cannot fail to be of extreme interest. One of the photographs from which the illustrations are made shows the terminal steel mast or rod with its guys in position, erected on the beach in front of a small villa, in one of the front rooms of which the receiving and transmitting apparatus is located. Another of the photographs shows the interior of the room and two of Marconi's assistants engaged in receiving a telegram from the English coast, thirty miles distant. Messages are dispatched with perfect freedom from the vertical mast on the French coast to that on the English coast, and vice versa. At the time that the photograph was being taken the "Cassini," with M. Lockroy, Secretary of the French Navy, on board, passed down the Channel within view of the French coast. The assistants on noticing the ship transmitted the news across the Channel, and in less than a minute a reply was received, "If the secretary comes to see you, give him a good reception." The Morse receiver is used, and the message is written on the tape in the usual dots and dashes of the Morse code. In view of the large amount of visionary speculation that has been indulged in by some of the investigators of wireless telegraphy, there is something decidedly refreshing in the businesslike methods and practical results which have characterized the work of this brilliant young Italian.

SINE-WAVE TELEGRAPHY.

The system of sine-wave telegraphy invented by Messrs. Crehore and Squire was recently made the subject of a long-distance test, in which the remarkable feat of transmitting 120,000 words an hour was accomplished. The experiments were carried out under the direction of Gen. Greely, chief of the Signal Service, between Fort Myer, Virginia, and the War Department, Washington. Kipling's celebrated poem, "The White Man's Burden," was transmitted back and forth continuously between these points for the space of an hour, and it was found that the total number of words dispatched was 120,000, a rate of 2,000 to the minute. In the matter of speed and distance, this test has been exceeded by one carried out by the inventors in October, 1898, when they reached a speed of 3,000 words a minute over a cable between New York and Canso, Nova Scotia.

The sine-wave system makes use of the regular telegraphic wires. The telegraphic characters are punched in a paper tape, similar to those used in the stock tickers, and the tape is fed to a transmitter, which, by an ingenious application of the principles of the alternating current, sends messages with extraordinary rapidity to a polarizing receiver, in which, by means of a rotating photographic plate, the message is reproduced. At the time of the earlier experiments we devoted considerable space to the subject, and the reader is referred to the SCIENTIFIC AMERICAN SUPPLEMENT for May 8 and 15, 1897, and March 19, 1898, for complete illustrations of the apparatus, and a lengthy description by the authors of the system.

OFFICIAL TEST OF THE NEW ARMY WIRE GUN.

The United States army is testing the wire-wound principle of gun construction on a scale and with a thoroughness which will settle the value of the system one way or the other to the satisfaction of all parties concerned, whether lay or professional. The trials, as far as they have gone, are strongly in favor of the system, and unless some mishap occurs before the specified number of rounds has been fired, the army will be in possession of fifty of the most efficient guns, for their weight, in this country, and certainly the strongest guns that have ever been turned out in the history of the art of gun construction.

One of the chief objects of constructing guns by shrinking hoops or winding wire upon an inner tube is to throw all the metal of the gun into a condition of initial strain, or in other words, to compress the interior metal and stretch the exterior metal. By thus wrapping the metal tightly around the bore, as it were, the pressure of the powder at the instant of firing is felt and resisted by every particle of metal in the gun. In a finished built-up gun the metal at the bore is in compression, and that at the circumference in tension, the strains passing from compression to tension, with a neutral point somewhere midway in the body of the metal. The greater the compression at the bore, the stronger the gun, other things being equal. There is a limit, however, to the allowable compression, for if we shrink the hoops or wind the wire too tightly, the metal at the bore will be injured. We must not compress it beyond its elastic limit, and hence we see that the strength of the built-up gun is primarily dependent upon the elastic compressive limit of the metal at the bore. In the common type of built-up gun the core upon which the hoops are shrunk is a forged tube of steel; and while it is possible by careful work in forging and tempering to bring the steel up to a high standard of elastic compressive strength, this tube steel does not by any means represent the highest elastic limit that can be produced by special methods of work on steel in other than tubular shapes.

It occurred to Mr. J. H. Brown, the inventor of the wire gun now under consideration, that if a tube were built up of separate longitudinal segments, it would be possible to subject them to a cold-drawing process and secure the extraordinarily high elastic qualities which result from cold work. Under his system a number of flat tapered bars of open hearth steel are cold-drawn to such a width, thickness, taper, and length, that when assembled and clamped together they form a tube answering to the forged tube of the ordinary gun, but possessing vastly greater qualities of resistance. Upon this segmental core the wire is wound at a certain tension, until the desired degree of compression of the core is reached. The core serves merely to receive and carry, as it were, the accumulated tension of the successive windings of the wire, so that when the gun is fired the pressure may pass through the core (which, of course, has no power of tangential resistance) and be immediately resisted by the wire. The high quality of steel that can be secured in this type of gun was shown in the tests of the metal put into the first gun of the type tested by the army officials, the segments showing an elastic strength of 126,000 pounds and a breaking strength of 176,000 pounds to the square inch, while the respective figures for the wire were 230,000 pounds and 262,000 pounds to the square inch.

The excellence of this system of construction is shown in the ballistic figures of a 5-inch segmental gun tested a few years ago at Sandy Hook with brown powder, when 216 rounds were fired with abnormally high pressures and velocities, which reached in the 157th round a maximum of 82,600 pounds pressure in the powder chamber with a resultant velocity of 3,235 feet per second. A 10-inch experimental gun was then ordered by the army and is to be tested this summer, and this was followed, in 1898, by an order for twenty-five 5-inch and twenty-five 6-inch rapid-fire guns on the same system. The terms of the contract for these guns require that they shall develop a velocity of 2,600 feet per second with a maximum chamber pressure not to exceed 45,000 pounds per square inch. The first or "type" gun is to be fired as many rounds as will develop the same amount of scoring as would result from 300 rounds with the old brown prismatic powder.

The first one hundred rounds have recently been completed by the government officials, and an extract of the highly satisfactory firing-sheet is herewith presented:

OFFICIAL TEST OF 5-INCH SEGMENTAL TUBE WIRE GUN.

Round.	Powder Charge. Smokeless Powder. Lb.	Oz.	Muzzle Velocity.	Pressure per Square Inch of Bore.
1	10	..	....	*18,000 lb.
2	12	..		21,050 "
3	15	..	2,705	32,800 "
4	16	..	2,821	35,750 "
33	14	6	2,601	30,000 "

* Should read less than 18,000 lbs.

In the first few warming-up rounds the pressure was run up from less than 18,000 pounds toward the maximum of 45,000 pounds, but at 35,750 pounds the velocity was already 221 feet above the contract velocity, and the powder charges were gradually reduced to 14 pounds 6 ounces of the new army smokeless powder at the thirty-third round, which gave a fairly constant velocity of 2,600 feet for a pressure of about 30,000 pounds in the chamber. The last five shots will be fired at between 45,000 and 50,000 pounds pressure, under which a maximum velocity of between 3,200 and 3,300 feet per second may be expected.

WHAT OUR CONSULS ARE DOING FOR AMERICAN TRADE.

We have, on another occasion, referred to the great value of the reports of the United States Consuls, and it seems that their enterprise is leading to trouble in Germany. The American Consul at Leipsic requested the Chamber of Commerce of that city to furnish him with certain information concerning the preparation of rabbit's skin for the hat trade. The Chamber replied that, although it was desirous of promoting the trade of Germany with foreign countries, it must, as a matter of principle, decline to furnish technical reports on German manufactures that would be likely to assist foreign competitors. The Leipziger Faerber Zeitung published the following, headed "Unfair Competition! Industrial Espionage by the Consuls of the United States." The article goes on to say: "It was left to the present administration of the 'Great' republic on the other side of the great lake to degrade a government's commercial agents to industrial spies. A report of Consul-General Frank H. Mason, of Frankfort-on-the-Main (formerly at Chemnitz) begins with the following significant words: 'I have the honor to confirm the receipt of the special instructions of the department in which I was ordered to give, in a report, such detailed information regarding the production of the tar-dye-stuffs as would enable an experienced chemist to manufacture such dye-stuffs in America.' The poor Consul, after considerable spying, had to sit down and write a report, which we may be spared from reprinting. But it says therein quite correctly, 'It is useless for anyone, even an expert, to obtain from a German factory or laboratory secret information on the substances and processes which the owner of the process desires to keep secret.' Our government should send all Consuls who are caught at such vulgar espionage their passports at once."

A Hanover paper says, "The American Consul's practice of mixing in Germany's inmost concerns is becoming systematic." A papermaking trade journal states that a Consul who desired information on papermaking was even more inquisitive than the statistical department of the ministry of the interior. Anti-American papers all over Germany are making an en-

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ergetic campaign against the consular inquiries. They have to admit, however, that the reports of the American Consuls are most valuable, and they regret that German Consuls do not show the same enterprise. Naturally the German manufacturers are the first people to take exception to the splendid work which our Consuls are doing, for we are rapidly competing with Germany in many markets which she formerly held as her own. We hope that our Consuls will be able to continue to carry out their good work and that the value of their reports will not be impaired by refusals to give information.

These reports have become so far recognized as being of great value to our manufacturers that we publish the shorter and more important of these reports weekly in the SUPPLEMENT of the SCIENTIFIC AMERICAN, and we also publish a weekly index giving a complete list of all the reports issued by our Consuls.

AMERICAN MACHINE TOOLS IN ENGLAND.

Our esteemed contemporary, Industries and Iron, of London, has this to say regarding the increasing importation of American machine tools into England, and the causes therefor:

"It is in one sense gratifying, though not in another, that such a brisk trade is being done in this country with the United States in the importation of automatic machine tools. This trade is increasing day by day, since each machine acts as a kind of advertisement for another. Standard patterns and tools that do the most work in the least time, and at the least expense, are mainly accountable for the inroads which have recently been made to the prejudice of the engineering trades of this country. The recognized superiority of America in class tools is unreservedly recognized, though hypotheses vary as to the causes which have brought about this distinction. The general, though as we think erroneous, impression is that these highly elaborated machines have been brought to their present state of perfection through the absence in the States of what is commonly termed "cheap labor." We do not accept this as a tenable theory. Owing to circumstances, the inventive faculty is far more strongly developed in the United States than in this country. In America an inventive idea is regarded as a kind of marketable commodity, while in Great Britain the troubles of the inventor in getting his invention, however meritorious, into commercial form, are proverbial. For this the patent laws of this country are largely accountable. In both the United States and Germany the granting of a patent is a serious process, and one exercised with the greatest possible discrimination. Here anyone may obtain a patent for almost anything, so long as the fees are paid. The consequence is, that while both an American and a German patent are possessed of a certain, though doubtless undetermined, value, owing to the fact that their substance matter has been examined and judged patentable, in England the value of a patent is practically nothing."

It must be admitted that the above estimate of the situation is in the main correct, although there is one important particular to which we must take exception. While the average English patent has no such value as the American or German patent, an exception must be made in the case of the American inventor who, having secured the allowance of his United States patent, proceeds to take out a patent on the same invention in England.

An American patent is only granted after a thorough and painstaking search, not merely of American but all foreign records, has been made and the element of novelty has been clearly established. Hence an American inventor who applies for an English patent stands in the advantageous position of knowing that the novelty of his invention has already been well established, the claims having been drawn to avoid interference with prior English patents. It is obvious, therefore, that when our contemporary says, "in England the value of a patent is practically nothing," it says too much, the English patent of an American patentee having a special value due to the research and care with which the claims have been drawn.

THE HEAVENS IN MAY.

BY GARRETT P. SERVISS.

At 9 o'clock P. M. in the middle of May, the observer of the heavens will notice, directly in the south, a somewhat conspicuous quadrilateral figure among the stars. It is the constellation Corvus. Just above it Virgo appears, with her head upon the meridian and her feet far off toward the east, while her brightest star, Spica, glittering near her girdle, is clearly outshone by the planet Jupiter, which seems to be following from the east. Almost in the zenith a sprinkle of small stars indicates the presence there of Berenice's Hair, while between the zenith and the Pole Star the Great Dipper is balanced across the meridian, the handle to the east and the bowl to the west. Following the arch of the Zodiac westward appear Leo, Cancer, and Gemini, the latter near its setting point. East of Berenice's Hair and north of Jupiter is the great star Arcturus, with the circlet of the Northern Crown not far away toward the northeast. Below the Northern Crown, the eye, glancing toward the left hand, catches the brilliant rays of Vega in the constellation Lyra. The quadrilateral figure between the Northern Crown and Vega is the central part of the constellation Hercules, and the famous "Great Cluster" of Hercules is between the two stars of the quadrilateral next to the Crown, and nearest to the northern one. A small telescope will show it, on a moonless night, like a round twinkling nebula. Low in the southeast the reddish star Aldebaran has just risen.

THE PLANETS.

Mercury is a morning star, best seen about the 9th or 10th, an hour before sunrise. It is not, however, well placed for observation, and, being near aphelion, its brilliancy is diminished. It is in the constellation Pisces.

Venus is also a morning star, in Pisces, further west than Mercury, and, of course, more conspicuous. It is slowly overtaking the sun in its eastward motion.

Mars is in the constellation Cancer, between the stars Gamma and Delta, and does not set until late in the evening. The last opposition of Mars seems to have yielded little information to the astronomers. The distance between it and the earth is still rapidly increasing.

Jupiter, in Virgo, rises before sunset and crosses the meridian before midnight at the beginning of the month. Some remarkable changes in the appearance and arrangement of its belts have occurred, and the possessor of a four to six inch telescope will be repaid for any study he may devote to it. On the 5th, at 9:55 P. M., Eastern time, the shadow of Satellite I will appear on the planet. On the 6th, at 9 h. 21 m. 35 s., Satellite I will reappear from eclipse, close to the planet on the east side, a phenomenon worth witnessing, and readily visible with a small telescope. On the 13th the shadow of Satellite II will be seen on the planet after about 7:45 P. M., while Satellite I will be occulted at 8:40. On the 20th, after 10:30 o'clock, the shadows of both Satellites II and III will be seen on the planet, the former in advance and passing off a few minutes after 11 o'clock. On the 29th Satellite I will reappear from eclipse at 9 h. 32 m. 21 s., and Satellite II at 9 h. 52 m. 05 s.

Saturn, in Ophiuchus, just north of Scorpio, rises about 8 o'clock P. M. in the middle of the month. It will come into better position for observation in June.

Uranus is an hour ahead of Saturn in rising, but is also in the constellation Ophiuchus, north of the star Antares. It is in opposition to the sun on the 27th.

Neptune is in Taurus about a degree northerly from the star Zeta.

THE MOON.

New moon occurs on the 9th about noon, first quarter on the 17th about noon, full moon on the 24th about midnight, and last quarter on the 2d about noon.

The lunar conjunctions with the planets take place on the following dates: Venus, 7th; Mercury, 7th; Neptune, 12th; Mars, 16th; Jupiter, 22d; Uranus, 25th; Saturn, 26th.

The moon is in perigee on the 1st, and in apogee on the 16th.

NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The regular annual session of the National Academy of Sciences began its meetings in Washington on April 18. The place of meeting was the auditorium of Columbian University. This organization, as is well known, holds an advisory character to the government, and by law is required to meet on the third Tuesday in April of each year at the capital. Its membership, which is limited to 100, includes only the most distinguished representatives in the various branches of science.

The special interest that is attached to the spring meeting is the business that is transacted, and on the present occasion the various matters discussed made the meeting an important one. The presiding officer was Dr. Wolcott Gibbs, of Newport, R. I., who is now one of the three surviving original founders of the academy. It is not possible to discuss the various papers that were presented before the academy, and we must therefore content ourselves with simply mentioning their names. This action is almost necessary for the reason that many of the distinguished speakers content themselves with simply announcing the papers that they have prepared by title, while others whose papers are more lengthy describe them to the academy in a short extempore summary of their contents. It may be said, however, that the papers by Mr. Charles D. Walcott, Superintendent of the United States Geological Survey, and that by Mr. Henry S. Pritchett, Superintendent of the Coast and Geodetic Survey, and also that by Prof. Newcomb, were essentially descriptive of the work accomplished by the offices under their supervision.

"On the Diamond and Gold Mines of South Africa," "On the Tawner Deep Sea Tow Net," by Alexander Agassiz; "On the Acalephs of the East Coast of the United States," by Alexander Agassiz and A. G. Mayer; "On the Limestones of Fiji," by E. C. Andrews; and "On the Bololo of Fiji and Samoa," by W. McM. Woodworth, both of which were communicated by Alexander Agassiz; "On the Development by Selection of Supernumerary Mammæ in Sheep," and a discussion "On Kites with Radial Wings," by Alexander Graham Bell; "Ophiura Brevispina," by William K. Brooks and Caswell Grave; "The Shadow of a Planet," by Asaph Hall; "Remarks on the Work of the Nautical Almanac Office During the Years 1877-98 in the Field of Theoretical Astronomy," by Simon Newcomb; "The Resulting Differences Between the Astronomic and Geodetic Latitudes and Longitudes in the Triangulation along the Thirty-ninth Parallel," by Henry S. Pritchett; and "Progress in Surveying and Protection of the United States Forest Reserves," by Charles D. Walcott.

Of the public business transacted by the academy the following may be mentioned: The six members of the council that were elected were as follows: Prof. Simon Newcomb, Dr. Samuel P. Langley, Mr. Arnold Hague, Prof. George J. Brush, Prof. Henry P. Bowditch, and Dr. John S. Billings. The society has received by bequest on several occasions sums of money which have been invested so as to produce an income for the purpose of conferring medals upon men who have achieved special eminence in certain directions, and the Watson medal, founded by the widow of Prof. James C. Watson, which is of this character, was awarded to Mr. David Gill, the official astronomer of Great Britain at the Cape of Good Hope. The special work for which it was conferred was the perfection of the application of the heliometer to astronomical measurements.

An important feature of the spring meeting is the election of new members, and for the first time in several years the full quota of five, which is the limit imposed by the constitution, was elected. The successful candidates were as follows: Charles Emerson Beecher, who is connected with the paleontological department of Yale University, and who was for many years an assistant of the late Prof. Othniel C. Marsh; Prof. George C. Comstock, the astronomer who holds the office of director of Washburn Observatory in Madison, Wis.; Prof. Theodore William Richards, who is assistant professor of chemistry in Harvard University and the successor of the late Prof. Josiah P. Cooke. Prof. Richards' work on atomic weights has gained for him a more than national reputation; Edgar F. Smith, professor of chemistry in the University of Pennsylvania, whose specialty is the electrolytic deposition of metals; and Edmund B. Wilson, the biologist, who is connected with Columbia University, in New York city.

The Washington Academy of Sciences, a body that has recently been organized, tendered the National Academy a reception, at which a lecture was given by Prof. R. W. Wood, on the subject of photography of sound waves and color photography—arts in which this gentleman has done much that is new within the past few months. His remarks on photographing sound waves were of unusual interest, because they were accompanied by stereopticon slides portraying sound waves in motion, and were, it is claimed, the first ever produced in which the original and reflected waves were both represented on the plates. His exhibition of color photography was equally interesting, and his method of producing directly from nature photographs in the natural colors seems to promise success.

The usual social entertainment on this occasion was given by Prof. Alexander Graham Bell.

A PARISIAN EGG FORGER.

An egg forger has been recently exposed in Paris. Eggs are about the last thing that one would expect to be forged, but it should be remembered that there are many collectors of birds' eggs who are willing to pay a high price for rare birds' eggs. A visitor saw this clever forger make a penguin egg which could not be distinguished from the real one that served him for a model. He made the egg of plaster of Paris which he burnt and glazed. The egg was intended for a man who furnished eggs for a foreign scientific collection. It is not very difficult to impose on even experienced scientists, for among the real eggs of most species there are so many varieties that even the most practiced expert could not readily distinguish all of them. The eggs of the common fly catcher are very cheap and by chemical treatment they acquire a bluish, green, shiny color, and are then sold at high prices as the eggs of the silk tail. From common ducks' eggs are fabricated eggs of a falcon, being given a silver green color for the purpose. The pigeon and wood pigeon eggs are also transformed into rarer products of birds. Nightingales' eggs are difficult to procure and are therefore rare. They are successfully imitated by coloring larks' eggs brown. For a long time the egg forger was an assistant in a natural history museum in the provinces. There have been other cases of forgery of very rare birds' eggs, but these were only made of excessively rare eggs, and their manufacture did not constitute a permanent means of livelihood.

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THE MARVIN ELECTRIC ROCK DRILL.

It can no longer be truthfully said that electric engineering is in its infancy. It has arrived at a state of maturity which is marvelous. The introduction of electrical machinery for lighting and power has assumed gigantic proportions, and its extended application in other directions, especially in mining, is increasing at a prodigious rate.

The Marvin electric drill, as at present manufactured by the Marvin Electric Drill Company, of Canastota, N. Y., is one of the finest of recent achievements in electrical engineering. It embodies electrical principles of peculiar merit, and mechanical construction not surpassed by other machines, and a simplicity of operation and construction that is almost ideal.

The early electrical drills, which first made their appearance before the public in 1891, were enthusiastically received, but, owing to faulty design, they soon fell into disuse, and it was not until several years subsequently that the drill was brought to a sufficiently practical state to compete with other drills operated by compressed air or steam. Within the past few years the Marvin drill has undergone still further improvement, and these drills may now be found in successful operation under a wide variety of conditions.

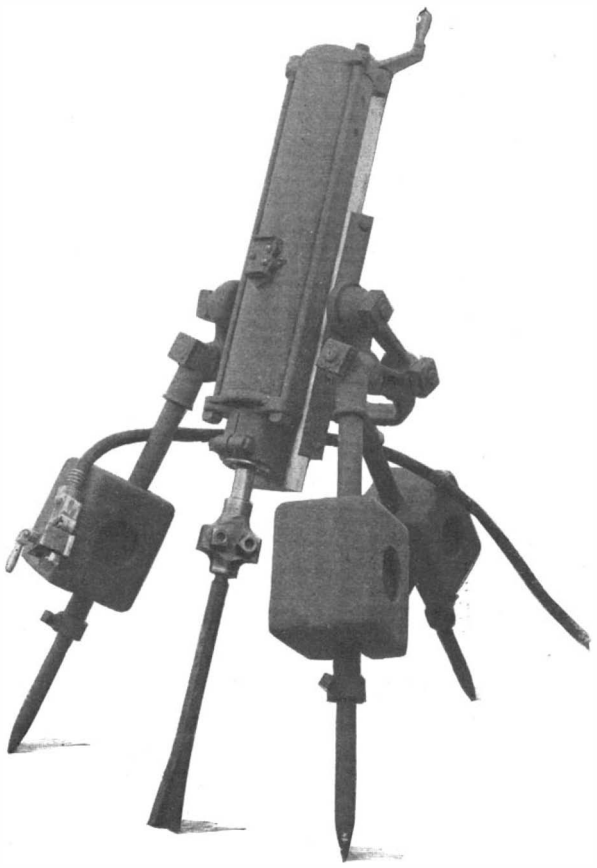

Fig. 1.—THE MARVIN ELECTRIC ROCK DRILL.

In the development of this drill, the inventor, Mr. H. N. Marvin, was confronted on all sides with difficulties, and the limitations prescribed by the exacting conditions necessary to a successful drill rendered the task an extremely difficult one. Those who have had anything to do with mining machinery will appreciate the many obstacles that have been surmounted in the perfecting of this drill.

The general operation of the drill is similar to those operated by steam or compressed air. An idea of the external appearance of the machine may be had by examining Fig. 1, which shows a 7-inch size drill mounted on a tripod. By inspecting Fig. 2, showing the drill in section, its simple and substantial construction will be understood. The different parts of the drill interlock, and are held together by two side bolts and two studs, the latter being integral with the concave slide upon which the parts are held. Referring to Fig. 2, it will be observed that the body of the drill consists mainly of two coils of wire, 3 3, which form a double solenoid. Within this solenoid is developed the magnetic force which drives a soft steel plunger, 1, to and fro, in the same manner that steam actuates the piston in a steam drill. The plunger, which is turned from a solid steel forging, has a reduced section or neck, 4, which passes through a bearing, 11, in the front-head, 5, and terminates in a massive chuck, 6, for holding the drill steel or bit. The other end of the plunger is enlarged to form a magnet, 2. Into the end of the magnet is screwed a rifled nut, through which the rifled bar, 8, passes. On the end of the rifled bar is keyed a ratchet wheel. Pawls (not shown in cut) engage in the teeth of the ratchet wheel and prevent the rifled bar from turning backward. By this arrangement the plunger is rotated through a small arc during every backward stroke. The buffing spring, 7, which closely resembles a car spring, checks the backward stroke of the plunger and returns the energy momentarily stored in the spring to the forward stroke.

The construction of the coils, 3 3, is of particular interest, being peculiar to this machine. They are wound with square copper wire and insulated with pure India mica placed between turns and layers. The absence of organic insulation makes the construction of these coils fireproof, and the square wire tightly pressed into place prevents any disturbance of the insulation by the vibration of the machine. Both coils are wound upon a steel spool and then slipped into a boiler iron tube. The jacket thus formed is hermetically sealed, by calked joints, at the junction of the tube and heads. Electrical connection with the winding of these coils is made with three contact plugs, 10, which press into three metal rings located between the windings. External connection is made with these plugs by means of a connection fitted to the end of a flexible cable.

One of the most noteworthy features of the drill is the entire absence of anything in the nature of a switch or valve, this being unnecessary, as the current is alternately directed into the coils by the generator itself.

The drill generator or dynamo, shown in Fig. 3, is a two-pole machine with a drum armature containing a loop winding embedded in slots, which are disposed over a portion of the periphery, filling opposite arcs. In this a single phase alternating current is generated. Referring to the diagrammatic sketch, Fig. 4, it will be observed that one end of the loop winding terminates in a solid collector ring; the other terminates in a half ring, which alternately shifts the current into the two sides of the drill circuit by means of brushes resting upon the commutator at diametrically opposite points. No appreciable sparking results, as the half ring leaves each brush at the instant when the current wave is zero.

Three wires are required to transmit the current to the drills. Fig. 4 shows the arrangement of the circuits and the path of the current. By tracing the development of the current in the armature and its course through the circuits, it will be noticed that one outside wire receives positive pulsations or waves of current and the other outside wire receives negative pulsations, and that the flow of the current in the drill coils is such as to always magnetize the plunger one way. The magnetism is, in other words, never reversed. Likewise the dynamo field is overcompounded by the coils, *A A*, which receive the current that passes through the drills. The object of the overcompounding is to maintain a uniform pressure of about 135 volts at the drills, whether one or more are working. The middle wire is the common return for both phases of the current. The speed of this machine is usually 380 revolutions per minute. Every revolution of the armature produces one complete stroke of the drill. The field of this machine is excited by coils, *B B*, which receive current from a small exciter, as the generator is not self-exciting. The exciter is belted from a small pulley on the shaft of the drill generator. The exciter usually furnished is capable of supply current sufficient to maintain about fourteen 110 volt incandescent lamps at 16 candle power each, in addition to the current delivered to the field of the generator. In place of the small exciter one of any desired capacity can be used; thus making it possible to operate motors, fans, and other electrical devices from this machine.

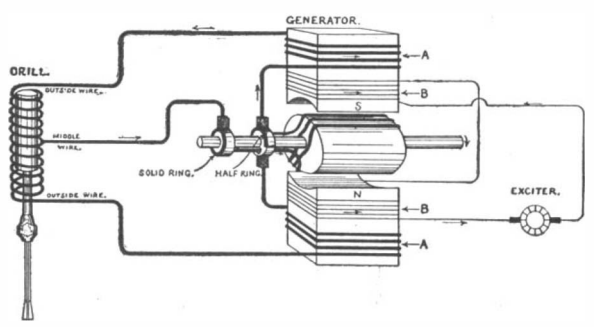

Fig. 4.—DIAGRAM OF THE CIRCUIT.

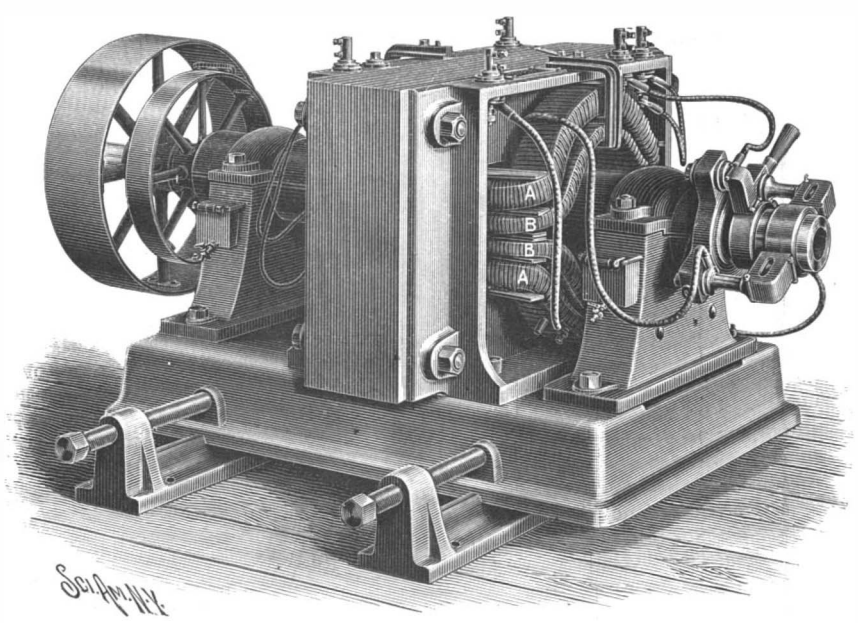

Fig. 3.—THE GENERATOR.

The field of the generator is of rectangular shape and built up entirely of sheet iron punchings. Into side channels in these punchings are laid the field coils, which completely surround the armature. The generator is so constructed that it may be subdivided into small packages for transportation by mule back to localities difficult of access.

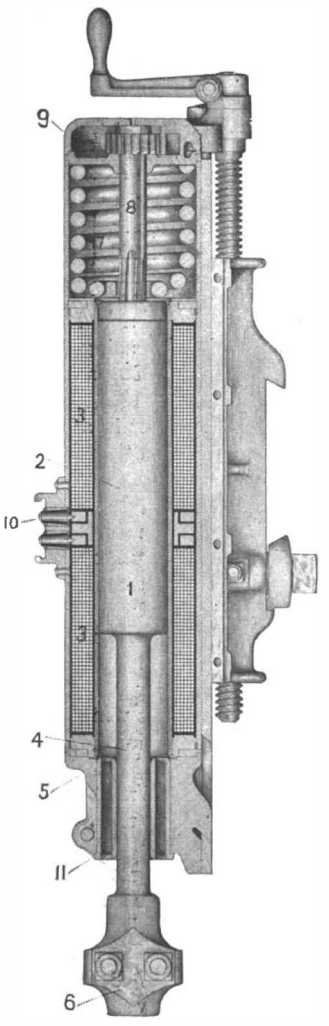

Fig. 2.—LONGITUDINAL SECTION OF THE MARVIN ROCK DRILL.

The electrical features of the system are so extremely simple that no electrician is required to attend to its operation, and the drills themselves may be operated to good advantage by laboring men of ordinary intelligence.

The most striking feature of the Marvin system is its flexibility, of which the plant herein described may serve as a typical illustration. In the fall of 1896 a four-drill plant was installed at Mine la Motte, Mo., for operating four 6-inch Marvin drills in four different underground leads, located a considerable distance from each other. Mine la Motte was discovered by the French, in 1717, and is one of the oldest mines in this country. This mine was once famous for its nickel and cobalt, but of late years, lead is its chief product, of which there seems to be an unlimited supply.

The rock largely encountered in this mine is exceptionally hard dolomite, carrying about 20 per cent of silica. The drills in this mine work to particular advantage, owing to the very large face walls upon which they operate, and which permit of eight-foot holes being drilled and a large amount of rock broken at one time. The wires for conveying the current to the drills are carried along the surface of the ground upon poles in the usual manner and are led down to the mines below through existing prospecting holes. Bare copper wires are used to convey the current above ground and rubber-covered wires protected by several layers of sticky tape are led through the prospecting holes to the drills in the working below. The operation of the four-drill plant was so successful that the owner of the mine, Mr. S. H. Leathe, soon afterward installed an additional generator to operate two drills from wires extending above ground 6,400 feet. When the wires extend under ground they are carefully protected from moisture. A separate switchboard is provided for each generator. Each 6-inch drill consumes about 6 horse power delivered to the generator pulley. This is in marked contrast to the power required to operate air or steam drills of similar size. In addition to the economical operation, both as regards drilling, efficiency, and cheap maintenance, may be mentioned the simplicity of the electric generator as compared with an air compressor, which is of complicated construction. There is no deafening exhaust to the electric drills, and they work equally well at all elevations.

In conclusion, it may be said that the Marvin drill possesses many points of superiority not touched upon in this article.

At last bicycle manufacturing has been considered worthy of regular instruction, and a technical class on "Cycle Construction" has been commenced at the Battersea Polytechnic, London. The class meets one evening a week from 7:30 to 9:30. Valuable testing apparatus will be provided and comparative tests will be inaugurated. This will prove of great benefit, as independent tests of parts of materials used in cycle construction have not been made in England.

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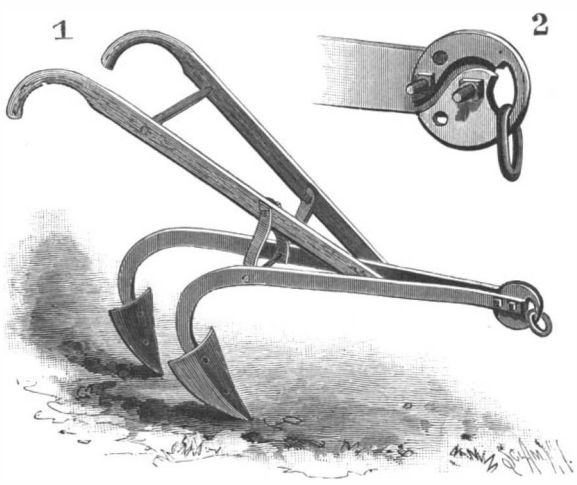
Effect of Storms on Birds.

The effect of approaching storms upon song birds is the subject of an interesting contribution by Mr. C. E. Linney to The United States Monthly Weather Review. It appears that during the night of August 15–16, 1898, severe electrical, wind, and rain storms prevailed over the northern district of Illinois. An observer in Henry County, Mr. W. W. Warner, noticed that for forty-eight hours before the storm not a sound was heard from the numerous song birds in the district. This observation was so full of interest that Mr. Linney wrote for additional information, with the result that he received numerous letters, some confirming it; others stating that birds sing louder and more persistently before a great storm, and nearly all agreeing that they are more restless than usual at such a time. Mr. Linney has found the following weather proverbs referring to song birds and storms: When birds cease to sing, rain and thunder will probably occur. If birds in general pick their feathers, wash themselves, and fly to their nests, expect rain. Parrots and canaries dress their feathers and are wakeful the evening before a storm. If the peacock cries when he goes to roost, and, indeed, much at any time, it is a sign of rain. Long and loud singing of robins in the morning denotes rain. Robins will perch on the topmost branches of trees and whistle when a storm is approaching. The restlessness of domestic animals and barnyard fowls before an approaching storm is well known, and many of their peculiarities have been noted; but the actions of song birds do not appear to have previously received particular attention.

A CONVERTIBLE PLOW.

A plow has been invented by Willard C. Cousins, of Ferrum, Va., which can be readily converted into an ordinary single-shovel cultivator or double-shovel plow, and which can be easily adjusted to bring the draft at any desired point. Fig. 1 shows the plow arranged as a double-shovel cultivator. Fig. 2 illustrates a peculiar form of clevis employed. The plow is provided with two beams detachably connected by means of bolts. Of these plow-beams, one is somewhat longer than the other; so that one shovel is located in advance of the other, thus forming a double-shovel plow. When it is desired to arrange the parts to form a single-shovel plow, it is necessary merely to detach one plow-beam. The front ends of the beams are held together by two bolts, one of which passes centrally through the clevis-plate and the other eccentrically. At their rear ends the two beams are joined by a transverse screw-rod,



COUSINS' CONVERTIBLE PLOW.

by means of which the distance between the beams and shovels can be regulated. The plow-handles are secured to the longer plow-beams, and, when two shovels are used, are held in position by means of detachable braces.

The clevis, as shown in Fig. 2, is disk-shaped, and is provided with centric and eccentric apertures to receive the two bolts previously mentioned. The eccentric apertures are three in number, and by their means the draught can be brought to any desired point. At its front end the clevis is provided with an opening to receive a solid ring which is designed to engage the whiffletree hook, and which enters the opening by means of a curved slot. The front ends of the beams are recessed to receive the ring. The ring is adapted to be confined at the top, bottom, or center of the beam recesses, depending upon which eccentric perforation in the clevis is used in conjunction with the bolt.

The plow is simple and cheap in construction, is capable of being easily converted into a single or double shovel cultivator, and of being adjusted to vary the draft and bring the ring at the top, bottom, or center of the front ends of the plow-beam.

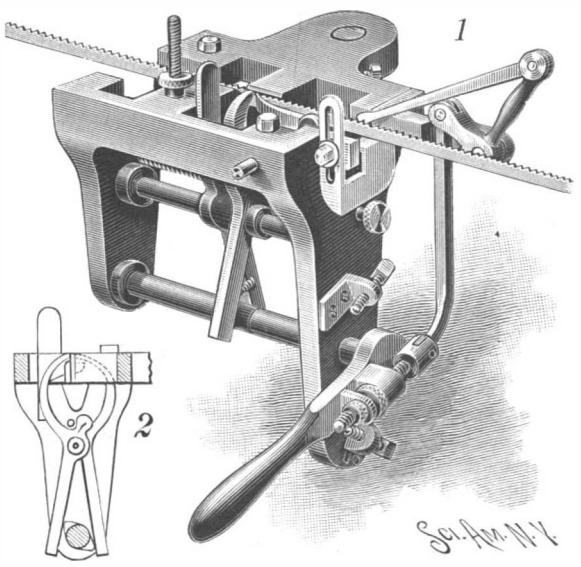
IN the disinfection of stock cars on the Continent it has been found impossible to obtain satisfactory results with either carbolic acid, steam, or formaldehyde. Satisfactory results have, however, been obtained with a five per cent solution of chloride of lime.

AN IMPROVED BAND-SAW-SETTING MACHINE.

A band-saw-setting machine which is constructed to feed the saw forward properly, and to bring the teeth accurately into position for the setting-tools to act on the teeth, has been invented by Pierre Sicotte.

Fig. 1 of our illustrations shows the machine in perspective. Fig. 2 is a transverse section, showing the arrangement of the setting tools.

On the machine-frame vertically adjustable saw-



AN IMPROVED BAND-SAW-SETTING MACHINE.

rests are mounted, one of which is located adjacent to two anvils arranged to face the saw-blade on opposite sides. One of the anvils can be laterally adjusted for saws varying in thickness. On their upper ends the anvils are formed with bevels against which the corresponding saw-teeth are set by longitudinally adjustable setting-tools moving transversely to the saw and to the anvils. These setting-tools, as shown in Fig. 2, are pressed against the saw-teeth by means of cams on a rock-shaft journaled in the lower portion of the frame. To prevent the springing of the saw-blade during the setting, guide-fingers are employed, the free ends of which are arranged opposite the anvils to engage that portion of the blade directly under the tooth to be set at the time.

The saw is fed by means of a pawl which engages the teeth and which is operated by a bell-crank lever connected by a link with an arm which is secured to the rock-shaft previously mentioned, and which, therefore, coacts with the cams operating the setting-tools. An adjusting device is carried on the arm to give any desired throw to the pawl, according to the size of the teeth of the saw to be set, without, however, changing the opening and closing device for the setting-tools. In their normal positions, the setting-tools are out of engagement with the saw, When the arm secured to the rock-shaft is swung down, the cams on the rock-shaft force the setting-tools into engagement with the corresponding teeth of the saw, to set these teeth in opposite directions. Hence, two saw-teeth are set at one operation, without danger of springing the blade, owing to the arrangement of anvils and guide-fingers previously described. Simultaneously with the operation of the arm, the feeding-pawl will be operated through the medium of the connecting link and bell-crank lever, to move the saw forward. From the arrangement described it follows that the setting tools and feeding-device are both actuated by the operation of the arm.

The patents for this machine are controlled by the Helmers Manufacturing Company, of Leavenworth, Kans.

The New French Phosphorus Matches.

In 1895 the outcry against the horrors of phosphorus necrosis induced the French government to appoint a scientific commission under the presidency of Troost, charged with the task of finding, if possible, a substitute for yellow phosphorus. By September, 1897, that commission had almost resolved to report that none of the many preparations examined offered a solution of the problem, when Sévene and Cahen, of the state manufactory, submitted their matches. These matches contain phosphorus sesquisulphide and chlorate of potash. The sesquisulphide is a gray-yellowish substance, which is prepared by heating amorphous, i. e., non-poisonous, phosphorus and sulphur. The substance is very stable. Lemoine, who studied it in 1864, kept it for 15 years exposed to the air without noticing any change. Its latent heat is low; it ignites at 95° C. (203° Fah.), and can therefore be lighted by rubbing like ordinary phosphorus. The mixture with chlorate of potash burns quietly, while the mixture of amorphous phosphorus, which takes fire at 260° C. only, and chlorate of potash is really explosive. For this reason inert substances are added to the chlorate in safety matches; but we still occasionally find safety matches which spit unpleasantly. The new matches are not likely to contain other impurities than amorphous phosphorus and water. They have become popular during the few months they have been obtainable, and are known as the S. C. matches, after the initials of their inventors. The public may hardly have noticed the change, for in their appearance the new matches resemble the old; they may have a faint smell—more a sulphide than a phosphorus smell, however. The sesquisulphide, at any rate, has such a faint smell that the employés in the works are said not to complain about it. The new matches do not phosphoresce even when rubbed energetically, but they are poisonous to a very slight degree. The intending suicide would, however, have to swallow 6,000 matches to put an end to his troubles. We do not think, therefore, that the matches need be labeled "poison." If they can really be manufactured, transported, and stored with safety, and be relied upon to strike, the inventors have claims upon our gratitude. The S. C. matches are manufactured at Trélazé, Begles, and Saintines; no accidents have occurred as yet.—Engineering.

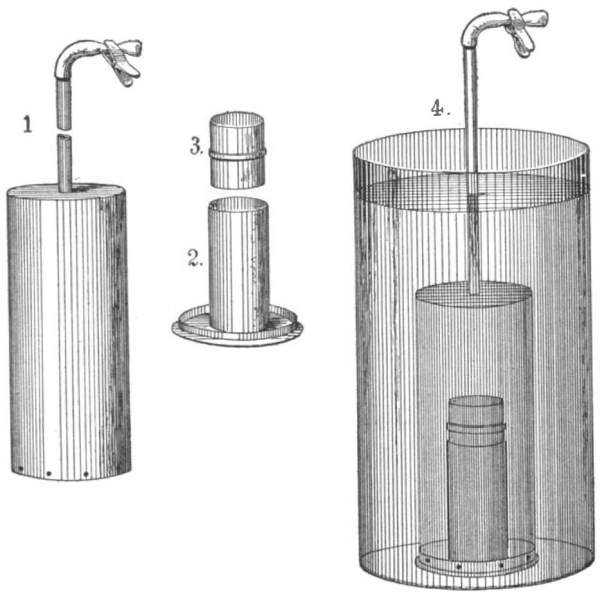
A CHEAP METHOD OF MAKING A CALORIMETER.

A calorimeter for determining approximately the heating value of any combustible solid, as coal, may be made at a cost of one dollar or less. The bomb calorimeters for making absolute calculations cost several hundred dollars; but where results do not need to be absolute and expensive instruments are not to be had, the instrument described below may be used, and with comparatively accurate results.

A sheet of heavy copper is made into a cylinder 7 inches high and 3 inches in diameter, as in Fig. 1. Over one end of the cylinder is soldered a copper cap, from which runs a copper tube perhaps ¼ of an inch in internal diameter. Let the tube be 12 inches high and have a stop-cock at its extremity, or, perhaps, have a few inches of flexible rubber tubing attached which shall have a pinch-cock. To the other end of the cylinder fit a movable cover with an inside, tightly fitting flange, like the cover to any small pail. Within this cover solder a copper cylinder 3 inches high and 1½ inches in diameter, as in Fig. 2. Next make a cup, as in Fig. 3, which is 1½ inches high and a trifle less than that in diameter, placing around it, on its middle line, a flange, so that it may be placed partly in the cylinder of Fig. 2. Obtain a glass jar 6 inches in diameter and 1 foot high, or with about these measurements. The completed calorimeter is shown in Fig. 4. Several holes are punched near the bottom of the outside cylinder to allow the egress of the gases and the ingress of the water from the glass jar.

The British thermal unit is the amount of heat necessary to raise the temperature of one pound of water from 39° F. to 40° F. Hence, if 3 grammes of fuel is burned in the cup and 2,901 cubic centimeters of water is present, the heating value will be as many calories as the temperature of the water is raised in degrees.

A mixture of 3 parts of potassium chlorate and 1 part of potassium nitrate is mixed with the fuel to supply oxygen for the combustion; and, as the nitrate absorbs heat and the chlorate gives off heat upon burning, when mixed as above the effect of each is



A SIMPLE CALORIMETER.

neutralized. After the combustion has taken place the stop-cock is opened, so that the water may fill the apparatus and absorb all the heat that has been evolved.

It is best to test the apparatus first with some fuel, as sugar, whose heating value is known, that the percentage of error may be reckoned in the results obtained with the fuels to be tested.

FRANK F. BRADLEY.

ON Prince Schwarzenberg's game preserves in Bohemia 106,604 wild animals were killed during last season. They include over 200 deer, 250 boars, 27,000 hares, 39,000 grouse, and 6,000 wild geese and ducks.

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Miscellaneous Notes and Receipts.

New Type Metal.—Instead of the current type metal consisting of lead, antimony, and tin of a specific gravity of about 11, a new alloy containing a large quantity of aluminum and possessing a specific gravity of 2·56–2·67 is said to have been invented. Besides being non-poisonous, other advantages, such as the quality of taking and giving off the ink more readily, etc., are claimed for this alloy.—Zeitschrift fuer die Buchdrucker Kunst.

Gilding of Glass or Porcelain.—To gild glass or porcelain, instead of the ordinary mixture a solution of gold chloride in oil of turpentine or lavender oil, to which a little bismuth nitrate and chrome soap have been added, is employed. The following mixture is said to give good results: Lavender oil, 900 grammes; gold chloride, 100 grammes; bismuth subnitrate, 5 grammes; chrome soap, 50 grammes. After the application allow the mass to dry and bake the articles in the muffle furnace. The gilt portions show a nice gloss, without any subsequent treatment.—Neueste Erfindungen und Erfahrungen.

Deodorization of Rubber Rings.—At the meeting of the Verein der Mineralwasser-Fabrikanten (Society of Manufacturers of Mineral Waters) the following methods of killing the smell of rubber rings were proposed, says the Zeitschrift fuer die gesammte Kohlensäure Industrie: Treating the rubber with solutions of caustic potash or caustic soda; treatment with potash or soda, since caustic potash and caustic soda injure the rubber; boiling with alkaline soaps; boiling with lescive phenix—calcined soda with water glass; and lastly, after treatment with soda, leaving the rubber for some time in a solution of cooking salt (10–15 per cent).

Grease for Wooden Combs.—Take equal parts of beeswax and finely crushed graphite, pour on varnish until it well covers the first two ingredients, and melt the whole over a very weak fire. When the mass is pretty thin, add soft soap, about half as much as wax, and boil. Another lubricant consists of the following: Wax, 25 parts; tallow, 50 parts; graphite, 10 parts; molybdena, 5 parts; soft soap, 5 parts; pine oil, 5 parts. This mixture is mixed hot and applied while warm. Finally, it is recommended to grease the wooden combs simply with pure beeswax, which is put on warm and quite thin.

For iron combs which are not smooth enough, wax dissolved with a little glass flour is employed.—Farben Zeitung.

New Process of Cleaning Bed Linen.—In a circular, the surgeon-general of the German army, Colar, in Berlin, calls the attention of the heads of the garrison hospitals to a new cleaning method, which is to be employed in future, as thorough experiments have proved it to be of advantage. According to this method, petroleum is added to the water besides soap and soda, taking as many grammes of it as there are liters of water used; e. g., 30 grammes of petroleum to 30 liters of water. This admixture of petroleum does not only admit of an easier cleaning, as well as less tear and wear on the linen, but the wash also retains its color, is thoroughly disinfected, and the expenses are considerably reduced by a saving in soap.—Neueste Erfindungen und Erfahrungen.

Leather Grease.—For the production of leather grease the Seifenfabrikant gives the following receipts:

1. Melt together 4 parts of vaseline and 1 part of wax or ceresine and add a coloring matter, if desired.

2. Well warm and mix vaseline, 15 parts; fish oil, 20 parts; tallow, 12 parts; and wax, 1 part. If a black color is desired, dye the vaseline and fish oil alone with lampblack and then add the tallow and wax. The whole is stirred cold and filled in cans.

3. Melt together yellow vaseline, 1 kilogramme; olive oil, 70 grammes; ceresine, ½ kilogramme; "lederine" yellow, 1 gramme, and stir until cooled.

4. Tallow, 71 parts; resin, 4 parts; castor oil, 38 parts. Dissolve the resin in the warm tallow, strain the whole, pour in the castor oil, and stir until, after standing some time, a light film forms on the surface of the fat. A black color is imparted with 5 parts of Frankfort black; for yellow, take only 66 parts of tallow in mixing, but add 5 parts of crude palm oil.

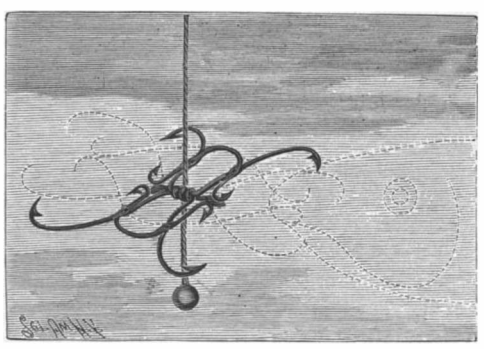
For perfuming the leather grease, oil of mirbane or oil of lavender is employed.

Green or Golden Color for Brass.—French articles of brass, both cast and made of sheet brass, mostly exhibit a golden color, which is produced by a copper coating. According to the Schweizerische Industrie Zeitung, this color is prepared as follows: Dissolve 50 grammes of caustic soda and 40 grammes of milk-sugar in 1 liter of water and boil a quarter of an hour. The solution finally acquires a dark yellow color. Now add to the mixture, which is removed from the fire, 40 grammes of concentrated cold blue vitriol solution. A red precipitate is obtained from blue vitriol, which falls to the bottom at 75° C. Next, a wooden sieve, fitting in the vessel, is put into the liquid with the polished brass articles. Toward the end of the second minute the golden color is usually dark enough. The sieve with the articles is taken out and the latter are washed and dried in sawdust. If they remain in the copper solution they soon assume a green color, which in a short time passes into yellow and bluish green and finally into the iridescent colors. These shades must be produced slowly at a temperature of 56°–57° C.

AN AUTOMATIC SPRING FISH-HOOK.

A patent has been granted to James Y. Payton, of Waldron, Ark., for a novel spring-hook which is constructed to close and catch a fish when the bait has been seized.

The fish-hook comprises two spring grab-hooks connected at their central bends and two spring bait-hooks pivoted to the grab-hooks and arranged symmetrically with relation to each other. When set, the hooks all lie in the same horizontal plane, the bait-hooks holding the grab-hooks distended as shown by



AN AUTOMATIC SPRING FISH-HOOK.

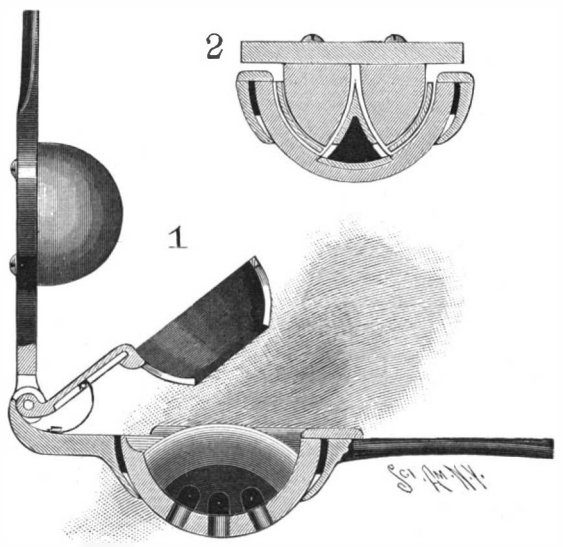
the full lines in the illustration. As each pair of hooks is maintained in unstable equilibrium, the hooks can be readily tripped by the fish, by a slight pull upon the bait-hook, by clamping or biting, or by causing a displacement of the abutting bait-hooks. The hooks' action depends upon the tendency of the springs to free themselves. Following this tendency the external grab-hooks, when the bait has been seized, approach each other, unless one of them be obstructed. But the obstruction of the one in its forward movement has no effect upon the other, since each hook acts independently by the tension of its spring. The dotted lines show the grab-hooks in the act of closing upon a fish, the bait-hooks projecting forwardly into the mouth of the fish, thus doubly securing it.

AN IMPROVED LEMON-SQUEEZER.

A lemon-squeezer has been invented by John W. Neal, Kealia, Kauai, Hawaiian Islands, in which two sections are hinged together and provided with a bowl and knife, so that, when the lemon is forced into the bowl by the movement of the sections toward each other, the knife will cut the lemon simultaneously with the squeezing,

Fig. 1 is a side elevation of the invention, with parts in section. Fig. 2 is a cross-section.

Of the two sections of the lemon-squeezer, the one



NEAL'S LEMON-SQUEEZER.

carries a bowl and the other a follower, both conforming with each other. Between the sections an ejector is mounted to swing, which is normally spring-pressed into the position shown in Fig. 1. Within the bowl of the one section a knife is secured which, as shown in Fig. 2, is adapted to enter a slot in the ejector and a slot in the follower.

In using the device, the lemon is placed in the ejector-cup. The follower-section is now thrown down, so that the follower engages the lemon and pushes it down with the ejector-cup, thus causing the fruit to be cut by the knife and simultaneously squeezed between the follower and the ejector-cup. After the lemon has been squeezed, the follower is raised; whereupon the ejector will be thrown to normal position by its spring, thus dislodging the lemon-rind.

Science Notes.

Thermometers for indicating low temperature may be filled with petroleum ether, which freezes at —190° Centigrade (—310° Fahrenheit). — Uhland's Wochenschrift.

Prof. J. K. Rees, Professor of Astronomy at Columbia College, has announced the gift of $10,000, the money to be used for the measurement and discussion of astronomical photographs. The gift was made by Miss Catherine Wolfe Bruce, who has previously made important gifts for astronomical work.

Consul-General Goodnow, of Shanghai, reports the arrival at that port of the surveying party which has just completed a survey of the proposed railway from Hankau to Canton under contract to an American company. No trouble was made by the inhabitants of the region and all kindness was shown and assistance given by the local gentry and officials.

United States Consul Higgins, of Dundee, sends an account of a plowing match near that city. These matches are held for the purpose of encouraging laborers to adopt this occupation. Prizes were awarded for plowing, for harness and grooming, and for "finishing" or clearing up furrows. Quite a few American plows are in use and opinions are favorable to their adoption.

A new Arctic expedition will soon sail from St. John's, Newfoundland, under the charge of A. Barclay Walker, the well-known English yachtsman. Mr. Walker intends to cruise in Arctic waters in the "Dundee," a steam whaler, during the next six months, with a party of scientists, including representatives of the Smithsonian Institution. They will probably attempt to reach the headquarters of Lieut. Peary, in Robeson Channel.

A locomotive headlight using acetylene gas has been devised by a Canadian inventor. The apparatus consists of a cylindrical cast-iron generator, five inches in diameter and twelve inches long, together with a water reservoir and condenser. The charge consists of about ten pounds of carbide, which is put in a wire basket and placed inside the generator. The water from the reservoir, dropping on the carbide, generates the gas, which is led through a small pipe in front of the reflector.

At the Rhode Island College of Agriculture and Mechanical Arts, at Kingston, a special course in poultry culture began on January 9 and continued for four weeks. Nearly forty applications for enrollment for the course were received, but, owing to limited accommodations, the class had to be kept down to about twenty in number. Several who could not take this course enrolled their names for the next one in 1900. It is a curious fact that even poultry raising has been thought worthy of a special course in an agricultural college.

Governor Roosevelt, of New York State, has signed the bill to prevent the spread of bacterial diseases and permitting witnesses to dispense with the kissing of the Bible in the administration of oaths. It is very satisfactory to note that proper sanitary regulations have now reached even the police courts, where they were badly needed. For a long time, however, many of the magistrates have not used the Bible in the court room, or have warned witnesses against using it, and great credit is due to Magistrate Pool, who inaugurated the move to do away with the kissing of the Bible in court.

McGill University, Montreal, Canada, will soon suffer a severe loss on account of the resignation of Dr. Nicholson, Professor of Mechanical Engineering, who, after eight years, has resigned to become the head of the mechanical and electrical engineering departments of the Great Municipal Technical School now being established at Manchester, England, at a cost of $600,000. The field of work which Dr. Nicholson will have opened to him is much larger than that at McGill University, for he will attempt to encourage research work on the part of managers and foremen of engineering and other establishments where they are brought into immediate contact with practical problems.

A new method of marking glasses of spirit levels and other instruments has been devised by a Connecticut concern making levels and other instruments. The usual way of marking glasses is to scratch lines on the surface of the glass, but the skin of the glass is thus weakened and the glass itself made very liable to fracture. In the new process, by fusing the glass at the mark and incorporating with it minute particles of metal, a colored line is obtained. The metal is embedded in and inclosed by the glass, which effectually protects it. In fact, the glass at the grooves has been so strengthened that it will break first at some other point. In addition, the line is absolutely indelible and permanent, and is sharp and well defined. This is effected by bringing the spirit tube up to an iron disk rotated at a velocity of about 2,500 revolutions per minute. The frictional heat generated practically fuses the glass at the point of contact with the wheel, and in this fused portion fine particles of iron given off by the wheel are embedded. A microscopic examination of the line proves this to be true. An actual mechanical union of iron and glass is the result.

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Correspondence.

The Migration of Locusts.

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of April 1 there is an article on the "Migration of Insects" by Prof. C. F. Holder. He tells of observing yellow butterflies thinly scattered over a good many square miles, all moving in one direction.

I have lived in the West and been familiar with the Kansas grasshoppers ever since 1857. I have seen them here in Denver; but most of my observations were in the vicinity of the Missouri River, in four different States—Nebraska, Kansas, Missouri, and Iowa. I believe they are not guided in the direction they move in their flights by any mysterious instinct, but are merely wafted away by the wind. In the fall they deposit their eggs in the ground wherever they happen to be at the time. These hatch on warm days the next spring. The earliest ones are generally killed by frosts. The young insects grow rapidly and hop about in search of food. They moult several times, and early in summer their wings appear. They then begin to fly. On cold or damp days, and especially when it rains, they stay near the ground, shielding themselves on the under side of leaves, fence rails, the eaves of houses, etc. But when the days are clear and warm, after filling themselves with grass, they will rise in the air about nine or ten in the morning, and flutter about, going to the right and left, up and down, but gradually ascending higher and higher till they are out of sight. If there is any breeze, and there almost always is, they will be carried off wherever the wind blows. Toward evening, getting tired and hungry, they descend to the ground, sometimes a hundred miles from where they started in the morning, and woe to the vegetation where they alight!

In appearance they resemble the common grasshopper, but have much longer and more powerful wings, and are able to remain in the air six or eight hours at a time. T. R. FISHER.

Denver, Col., April 12.

Action of Ice in Rivers.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 1, page 196, you give space to the statement of a traveler in Siberia, with reference to the bursting of the ice on the rivers there. It is not at all necessary to travel in Siberia to witness this phenomenon, as it is of quite common occurrence in this country, in the colder climates, on streams with rapid currents, and is particularly common on the middle and upper Missouri, as the old settlers along that stream will testify, and among whom these occurrences are familiarly known as "blow-outs."

As this Siberian traveler states, these "blow-outs" occur as a rule during severe weather only, at times when what are commonly known as "air holes" are frozen over. At such times on these northern streams, and particularly so on the Missouri River, with its immense volume of water and eight-mile or nine-mile current, these "blow-outs" are of very frequent occurrence, and are more remarkable than those described by the Siberian traveler, owing to the much greater thickness of ice blown out. I recall very vividly my own observations of the results of one of these "blow-outs" in particular, which will serve to describe them in general. In the month of January, 1893, I was engaged in teaming on the Missouri River one hundred miles above Yankton, South Dakota, hauling green cord wood down the frozen channel of the river for a distance of several miles, to a Missouri River ranch. During one noon hour a heavy report that could have been heard for miles, resembling the boom of heavy artillery or heavy thunder, was noted, and at the dinner table it was remarked that "there is another big blow-out on the river."

Upon my return trip, about three miles from the ranch, I was somewhat surprised to find the ice blown out directly in the roadway where some two hours before I had drawn a load of perhaps five tons weight. The space blown out would amount to perhaps one hundred feet square, with ragged edges and, of course, of irregular shape. The tremendous pressure necessary to accomplish this result may be judged from the fact that at this point the ice averaged twenty-six inches in thickness, solid, clear ice. Huge blocks of this ice several feet square were thrown to a distance of two hundred to three hundred feet, while smaller pieces and fragments were strewn to a distance of one thousand feet or more. Such were my observations of one of the "blow-outs" which, during long-continued severe winter weather, are of common occurrence on the upper Missouri, where the minimum thickness of ice is seldom, if ever, below fifteen inches, and ranging from that to three feet, averaging ordinarily about two feet.

While undoubtedly true, as the traveler states, that the prime cause of these "blow-outs" is the hydraulic pressure of the water, the fact that I found that little or no water had flowed over the edges upon the surrounding ice, and that the expansion of water under pressure would hardly be sufficient to throw the ice fragments to such distances, together with other observations, led me to the conclusion that the agency directly applied is compressed air. When intensely cold weather closes the "air holes," or safety valves, on these rapid streams, the ice under pressure naturally begins to rise slightly at the weaker points. This forms an air pocket, and the air, being carried underneath by the swift current, as a matter of course, rises and accumulates rapidly in these pockets. The ice is raised higher and higher as the volume of air increases, until, with the swiftly moving current, confined perhaps for miles above, acting as a compressor, the bursting point is reached, with the results before stated. The pressure is relieved, and another "blow-out" is not likely to occur in a distance of several miles, at least not so long as this one remains open. What the bursting pressure is under the conditions given in the foregoing can undoubtedly be quite accurately estimated by some of the readers of the SCIENTIFIC AMERICAN. A READER.

Pentwater, Mich., April 4, 1899.

The Zickler Wireless Telegraphy.

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of April 15, 1899, an article on a new system of wireless telegraphy, invented by Prof. Zickler.

It may interest you to know that this method of telegraphing by ultra-violet rays was invented by me more than ten years ago, in 1889. I used, however, a receiver almost infinitely more sensitive than that used by Prof. Zickler, i. e., the human eye, which is affected by an amount of energy which would be absolutely without action on a vacuum tube. The transmitter was the same as that described in your article, but the receiver was a circular dish of a fluorescent substance placed in a shallow vessel, with a reflector placed slightly above it in such a way as to focus the rays on the surface of the solution, or fluorescent glass. All visible rays were stopped out from the projector, however, but the receiver could tell at once from what direction the message was coming by looking at the direction of the fluorescent spot.

The reason why this system was never put on the market was one which Prof. Zickler will find when he has proceeded further. This is that the ultra-violet rays are very rapidly absorbed, especially over the waters of a harbor at nightfall, when there is any fog in the air.

This falling off is very rapid, and I have no hesitation in saying that I do not believe that Prof. Zickler has succeeded in actuating a vacuum tube at the distance of one mile by means of ultra-violet light. If he gets beyond 300 yards, I shall be surprised. Even with the eye I believe the limit to be about two miles, though possibly if I had had better apparatus I might have reached five or ten.

I therefore abandoned the ultra-violet light method for an infra-red one, which is much more promising, but of the practical use of which I am rather skeptical.

REGINALD A. FESSENDEN, M.A.I.E.E.,
Professor of Electrical Engineering.
Western University of Pennsylvania, Allegheny, Pa.

The Sixth Annual Reception of the New York Academy of Sciences.

The annual exhibition of progress in science occurred on April 19 and 20, at the Natural History Museum, and was well attended. One large hall of the museum had been set apart for the exhibits, which were arranged on temporary tables.

Entering the hall, the first subject noticed was astronomy. Hung on the wall were splendid enlarged photographs of the moon, taken with the Paris equatorial coudé, by Loewy and Puiseaux. Photographs of new stars, of meteors, of solar eclipses, and of the new satellite of Saturn, were of much interest. A firm in Cleveland, O., exhibited new telescopic gun sights, a sextant, and an improved 2-inch alt-azimuth telescope. Glass positives were exhibited by Prof. J. S. Ames, of the Johns Hopkins University, showing spectroscopic proof of iron in the sun.

In the botany section several interesting specimens were shown. Mrs. E. G. Britton had an exhibit of "Mosses New to the Eastern United States." Apparatus was shown for determining root pressure.

The section of chemistry covered numerous new compounds. Artificial coffee beans were shown. There was also an interesting specimen of tellurium extracted by sugar and examples of explosive compounds and specimens showing the effects of explosions on metals.

In electricity there were but one or two exhibits, the most important being a new incandescent lamp photometer by Queen & Company. The lamp to be tested is compared with a standard lamp and during the comparison is rotated so that all positions of the film may be tested.

The section of experimental psychology exhibited apparatus for the study of accuracy of movement, the study of binocular rivalry, and a simple photometer for measuring light intensities in schools by G. E. Johnson. This consisted of a horizontal disk having figures on its surface and perforations adjoining each other on its periphery.

Directly above the periphery is a pneumatic tube through which currents of air are projected, and, as the disk is revolved, pass through the perforations, causing a sound to be made relative to the speed of rotation. If the disk is rotated to produce the same sound and the intensity of light is such that the figures on the disk appear to blend together, then they harmonize, and one degree of light intensity is obtained from which comparisons with other degrees of light intensity can be found, by varying the speed of the disk. It was quite an interesting device and very simple.

In the section of physics there was, perhaps, the most interesting apparatus. We noticed the new form of stremmatograph, having a recording tape and arranged to obtain the strains under both rails for high speed trains. With this were also photographs of very rapid exposures (of one hundredth to one thousandth of a second) to show the position of the car wheels over the track at the point where the stremmatograph was located. Another apparatus was an improved Woehnelt's electrolytic interrupter designed by F. L. Tufts. This is arranged to operate in connection with a key and an induction coil and made quite a loud noise. In the construction of the conducting tube the use of mercury is omitted. The wire with the platinum point is carried directly through the tube to the bottom, where it is sealed, allowing the platinum point to project into the solution. The first glass tube is inclosed in another open glass tube. This, he claimed, gives better protection to the wire.

Prof. W. C. Peckham had an apparatus for showing the effect of an alternating current upon an incandescent lamp, and produced with it the same nodes and loop as in Meldes' experiments. The lamp was placed in front of an electromagnet and rotated in various positions. A lens projected the vibrations, greatly enlarged, upon a screen where they may be readily observed.

In the zoological section there was a large display of microscopes, all set to illustrate various preparations of crustacea and the breathing apparatus of fishes and other minute living organisms. In the section of geology and geography were some interesting topographical maps, one of which, the Yellowstone National Park (very large) has been prepared for the Paris Exposition of 1900 by the United States Geological Survey, at Washington. There were many large minerals and stones exhibited in the department of mineralogy, and in the section of paleontology were numerous exhibits of fish remains and the remains of large animals.

The exhibition was not as large or diversified as in former years, but contained features of much interest.

Fire Precautions in Paris.

In Paris theaters all but the electric light is forbidden and smoking is prohibited, except in the public smoking room, but a small fire was started recently in the Theatre Française by a cigarette which rolled through a grating in the sidewalk. This has caused officials to be even more strict than before. The comparative infrequency of fires in Paris is largely owing to the careful habits of the people and the excellent fire regulations regarding heating apparatus. When houses are built in Paris, the floors are invariably laid on brick and tiles; for, of course, the houses in Paris, with a few rare exceptions, are all what we term flats or apartment houses. The usual manner of building permits all the windows and balconies on the block to be on the same level, so that escape from one to the other is comparatively easy. This makes a uniformity which gives a very impressive character to the street architecture. The city authorities are now making precautionary fire regulations for hotels, including fire extinguishing apparatus, fireproof staircases, etc. It is very wise to adopt fire regulations at this time, when many hotels will be put up to accommodate visitors to the Exposition, next year.

The Manila Refrigerating Plant.

Further particulars regarding the refrigerating plant for Manila are now available. The approved plans of the War Department call for the erection of a large building to be equipped at a cost of $195,000, and the total cost of the plant will be about $300,000. What is known as the "direct expansion" system will be used. The low temperature will be obtained by the use of ammonia in coils of pipe in the various refrigerating rooms. It is believed that calcined pumice will be the material decided upon for insulation purposes, for materials which are used in temperate climates are of little value in the tropics. It is calculated that 1,200 tons of beef, 200 tons of mutton, 50 tons of butter, 100 tons of vegetables, and 100 tons of salt products can be stored. There will also be a "defrosting" plant for thawing out the meat before it is delivered to the commissary officers. Insulated boats will also be needed to ply between the supply steamers in the harbor and the shore.

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SUTRO BATHS OF SAN FRANCISCO.

BY F. W. PARSONS.

The most enduring monument to the memory of Adolph Sutro forms the subject of this descriptive sketch: The Sutro Baths of San Francisco.

Although this gigantic structure has been in active operation for two or three years, it is not well known.

The foundations for the bath buildings were hewn out of the rock, and a great catch basin, hollowed out by dynamite or giant powder, first receives the water as it dashes in upon the shore. From this pool, sea water is conveyed by tunnels to a settling tank; from the latter it is distributed through small canals to the six great swimming tanks that the baths provide. The largest tank is L-shaped, 350 feet long, 250 feet wide in its widest part and 150 feet wide in its narrowest section. This mammoth tank is largely filled with sea water at its natural temperature. The five smaller tanks are regulated to various temperatures, to suit the convenience of bathers. The tanks have an ocean frontage, and the buildings being of iron and glass, bathers can see and hear the waves breaking without.

Great ingenuity has been exercised in emptying the tanks in accordance with the most advanced ideas on sanitary engineering. All six tanks empty their waste water, ultimately, into one main outlet, and from that it is forced through pipes hundreds of feet beyond the neighboring headlands and passes out with the current into the open sea.

Great ingenuity has been shown in protecting the baths, on their seaward side, from any dangers of a stormy sea. A massive breakwater extends along the west side, 400 feet in length, 20 feet in depth, with a width at the top of 25 feet and a width at the base of 75 feet. It contains 450,000 cubic feet of rock. There is also another breakwater, 300 feet long, with the same depth and width as the one just described, but with 300,000 cubic feet of rock.

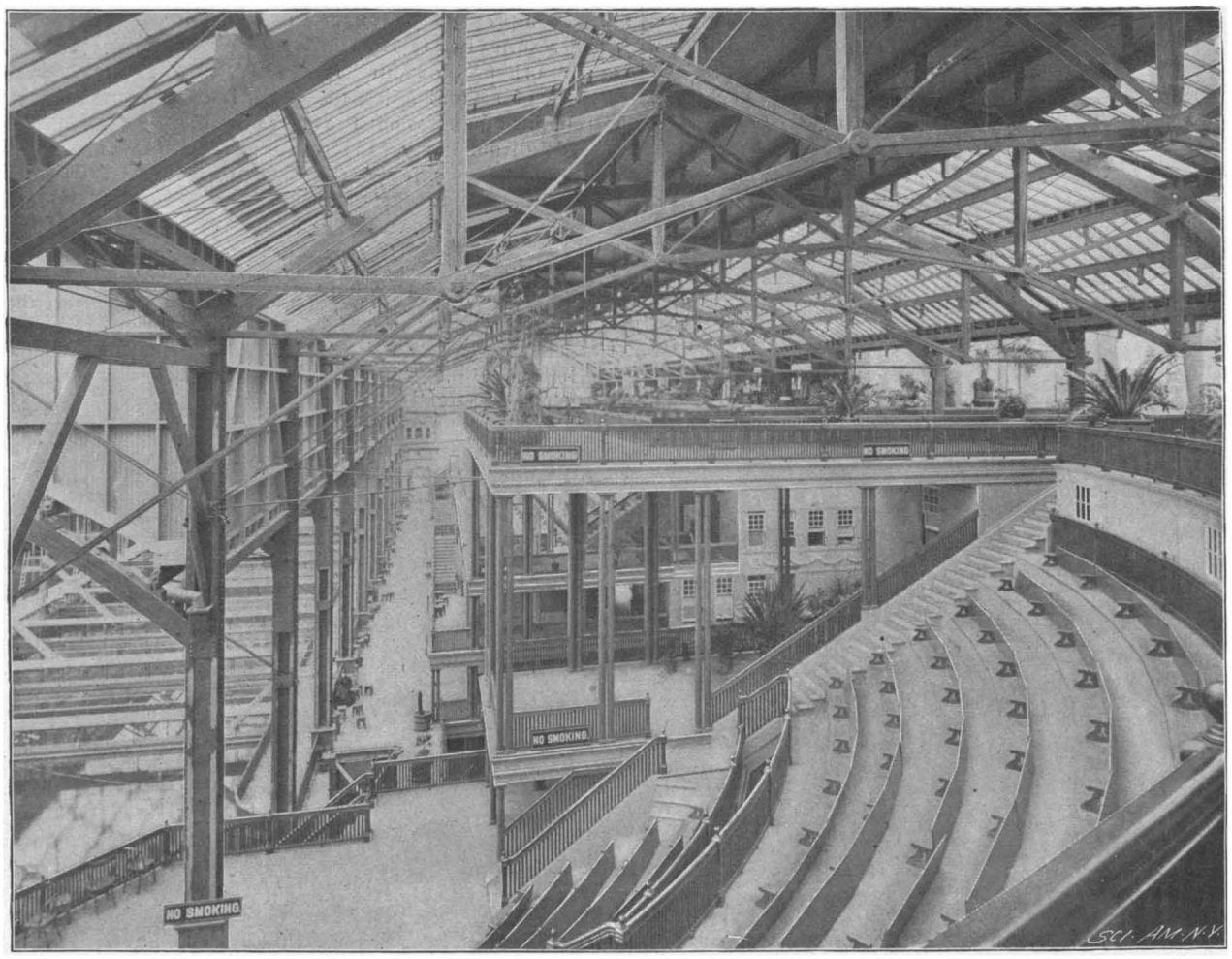
Provision is also made for exceptionally low water. Pumping facilities are provided, in case the tides should run unusually low, so that water can be forced into the tanks at the rate of 6,000 gallons per minute. The buildings are, in a measure, sheltered on the south, north, and east by cliffs rising higher than the baths themselves.

Just above the tanks is the gallery for bathers, with numerous corridors leading from it to the many dressing rooms. Above and beyond the gallery for bathers rises a gallery for spectators, and tier after tier of seats, somewhat similar to the Roman amphitheater. From every part of this vast auditorium the swimming tanks are visible. The seating capacity of the auditorium and spectators' promenade is estimated at 7,400.

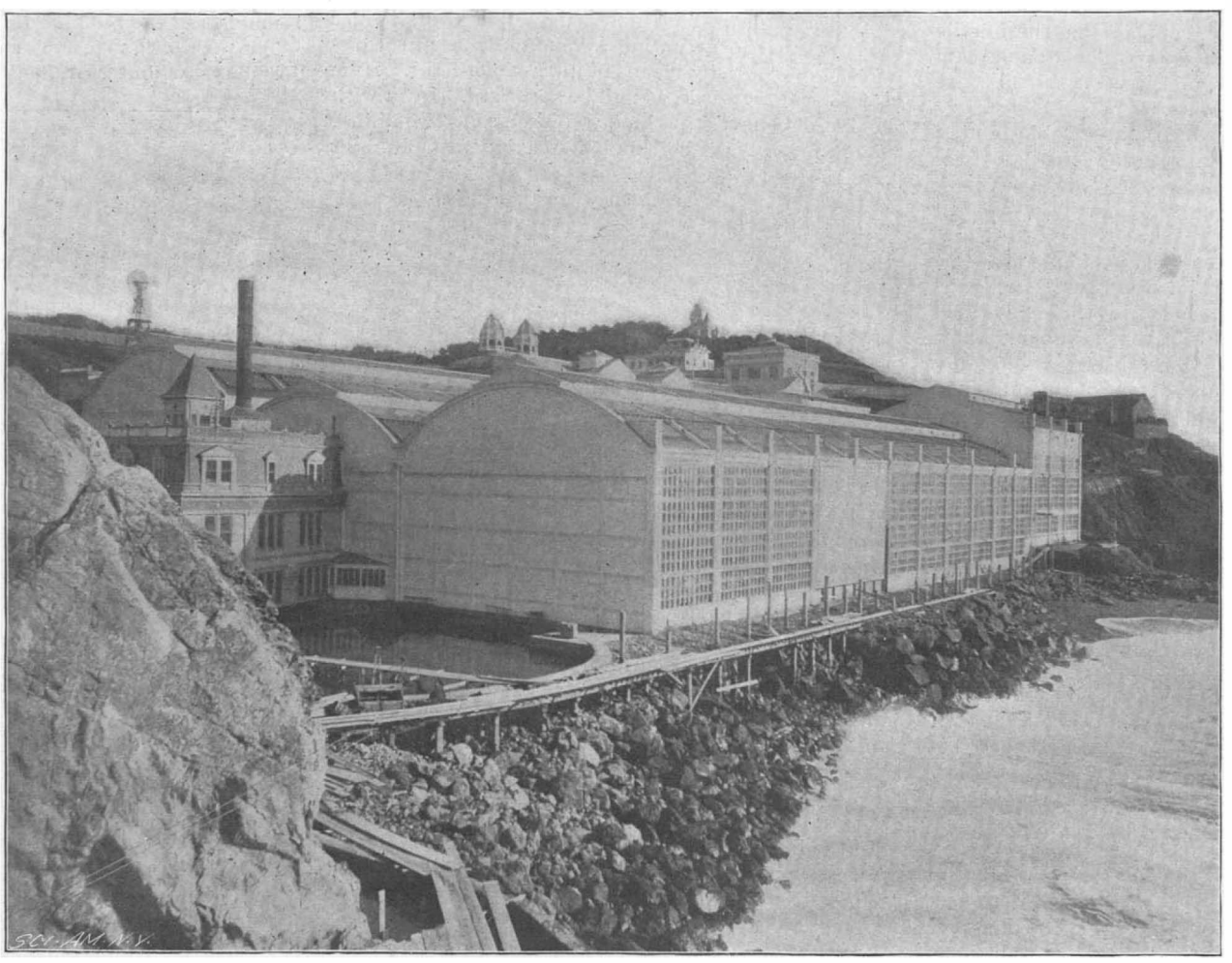
The main entrance to this great institution is on a land level much higher than the tanks. The main approach is through a classic temple, fronting on Point Lobos Avenue, a little north of the new Cliff House. The visitor descends a grand stairway, flanked by flowers and potted plants, to the original elevator promenade and museum galleries. Here are gathered together a collection of archæological and historic objects, state papers of Great Britain, curios from many parts of the world, constituting an exhibition in itself, and not at all what any one would naturally expect to see as an adjunct of a great bathing establishment. In the auditorium is a restaurant, comprising three floors, each 30 × 75 feet in size and with a capacity for 1,000 people. The restaurant verandas are just to the right of the stairway leading down to the main tank, as seen from the water, or on the left of those descending to the tank. A capacious kitchen is attached to the baths. The establishment also boasts a laundry, equipped with washer, drier, wringer, and ironer. Its capacity is equal to 20,000 suits and 40,000 towels per day. The buildings are lighted throughout by electricity.

The engines and boiler room are of unfailing interest to visitors with a taste for mechanics. Taken throughout, the Sutro Baths will comfortably house 25,000 people. Some approximate idea of the vast extent of the buildings, so happily combined with light, airiness, strength, and durability, can be gathered from the following data:

Length of baths	499·5 feet
Width of baths	254·1 feet
Amount of glass used	100,000 superficial feet
Iron in roof and columns	600 tons
Lumber	3,500,000 feet
Concrete	270,000 cubic feet
Capacity of the tanks	1,804,962 gallons



AMPHITHEATER AND PROMENADE, SUTRO BATHS.



EXTERIOR OF THE SUTRO BATHS, SAN FRANCISCO.

Besides the salt water tanks, already described, there is one fresh water plunge tank. In the way of apparatus there are 7 toboggan slides in the baths, 9 springboards, 3 trapezes, 1 high dive, and 30 swinging rings. There are 517 private dressing rooms, also club rooms, each of the latter with a capacity of accommodation for 9 bathers, the total rooming capacity of private and club dressing rooms amounting to 1,627. There are 69 shower baths.

Business at Guam.

The Navy Department has received a report made by the surgeon, Dr. Ward, of the cruiser "Bennington." Surgeon Ward went ashore and investigated the commercial products and mercantile establishments, during the stay of the "Bennington" in the harbor, with a view of determining what dependence could be placed on local markets for supporting the force to be kept on the island by the United States. At Agana, the chief town, he found eight so-called stores; in some of them he found it possible to buy cotton clothes of various colors, embroideries, shoes, matches, soap, candles, and a few varieties of poor canned goods, also Manila cigars of poor quality. A Japanese store was the best in the town: here were also sold imitations of imported wine, and very bad bread. The American store was more pretentious than any of the others, but was found to be inferior in many respects to the Japanese. A greater variety of goods were kept, including canned vegetables, meats, oil, musical instruments, lamps, crockery, trunks, nails, etc. Even such staple articles as flour are very hard to obtain. Milk, chickens, and eggs were plentiful, however, but the beef was poor. The chief native sources of food are bananas, cocoanuts, bread fruit, clams and oysters; besides, game, birds, ducks, etc., are plentiful.

According to a French medical journal, the London and Northwestern Railway Company has set up at Crewe an establishment or factory for making artificial hands, arms, and legs for its employés and injured passengers. These are supplied without charge to the recipients.

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MANUFACTURE OF KRAG-JORGENSEN RIFLES AT THE SPRINGFIELD ARMORY.—I.

Krag-Jorgensen is not the official name of the rifle with which the United States regular troops are armed. Officially this excellent weapon is known, or has been known, as the United States magazine rifle; but the rank and file of the army and the general public have fallen into the way of calling it by the names of its Norwegian and Danish inventors. The fame which it acquired under this name in the operations of the Spanish war has probably settled the matter for all time, and Krag-Jorgensen is likely to become the official as well as the popular designation of the United States army rifle.

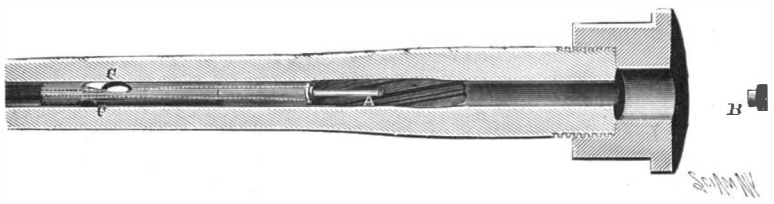
It would be an unpardonable omission to enter upon a description of the manufacture of this rifle without first giving attention to the famous Springfield Armory, in which not only this, but all other types of small arms of the United States army have been made from the stirring days of the Revolution to the present time. The selection of Springfield was due to Gen. Washington, who directed one of his ordnance officers to choose a suitable spot, well up the Connecticut Valley, for the erection of a national armory. Hence the spot on which the weapons used in the Spanish war were made is the same which rang with the sounds of warlike activity in the civil war of 1861, in the war of 1812, and in the heroic struggle of the Revolution.

About the year 1776 an arsenal for cleaning and repairing arms, and a powder magazine, were established in Springfield, the former in a building on what is now Market Street. The manufacture of arms was regularly begun in 1794 in rented buildings, and during the next ten years three water power sites on Mill River were purchased, upon which shops were erected, the principal one of which is now the Water Shops (Fig. 3), in which about 540 men are at present employed. The other two Water Shops were abandoned years ago.

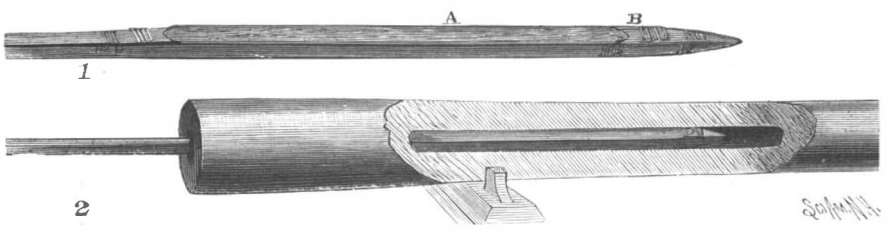
In 1801 the government purchased a tract of land on the rising ground above the city, which was subsequently enlarged by subsequent purchases. Here the extensive buildings known as the Hill Shops have been erected at different times. During the Mexican and civil wars the shops were enlarged and additional stories added. In 1889 and 1890 new shops were built on the hill by the present Chief of Ordnance, Gen. Buffington, then in command of the armory.

The water shops are occupied exclusively in the manufacture of the gun barrels and in preparing the rough forgings of all kinds that go to make up a complete rifle. The Hill Shops are devoted to the machining and completion of the receiver and the breech mechanism, the manufacture of the stocks and the assembling and testing of the rifles, the newer buildings being given up entirely to this work, while the older buildings on the hill, which did such good duty during the civil war, are now used as arsenals, museums, barracks, and offices. The commanding officer of the armory is Lieut.-Col. Isaac Arnold, Jr.; Major D. M. Taylor has charge of the Water Shops; the Hill Shops are in charge of Lieut. T. C. Dickson, and Lieut. O. C. Harney is paymaster and storekeeper. Our thanks are due to these gentlemen for courtesies extended during a recent visit to the arsenal.

The present article deals with the Water Shops, where finished gun barrels and complete forgings for the other parts of a rifle are turned out at the rate of four hundred sets a day. The raw material for the barrels goes to the works in the shape of round steel bars 1·15 inches in diameter (see Fig. 1). The specifications



5.—Rifling Cutter Head in Barrel.

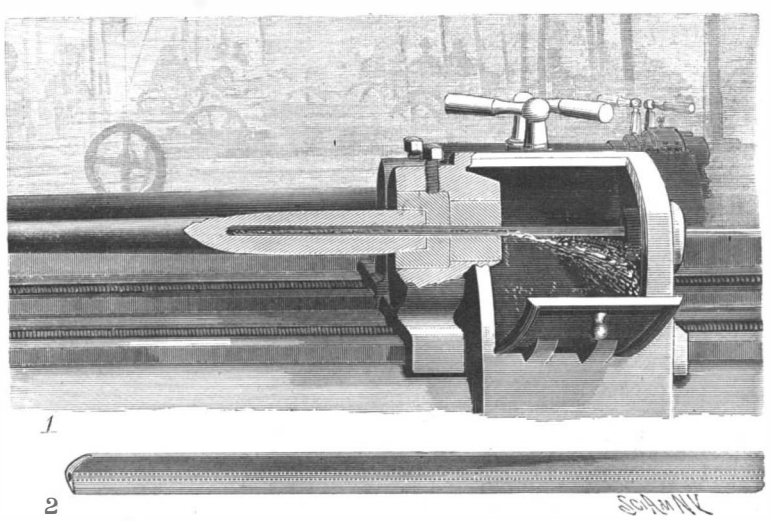


6.—Finish Reaming Bore of Barrel.

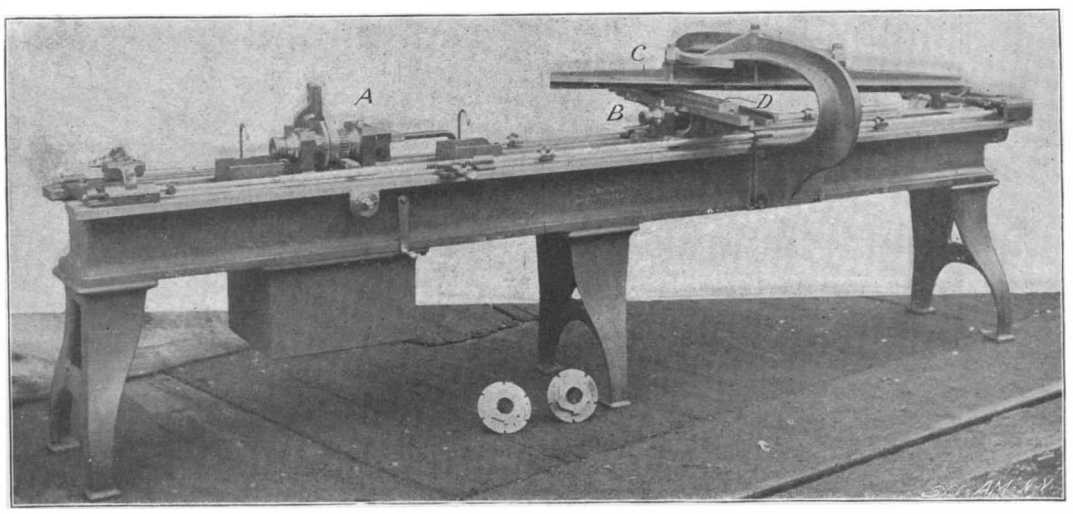
call for a simple carbon steel with an elastic limit of from 70,000 to 75,000 pounds; an ultimate tenacity of from 100,000 to 120,000 pounds; an elongation of from 15 to 20 per cent; and a contraction of from 35 to 45 per cent. The analysis of the steel must show about 0·50 of carbon, 0·80 to 1·00 of manganese, 0·10 to 0·18 of silicon, not above 0·08 of sulphur or 0·06 of phosphorus, and no nickel. The Ordnance Department reserves the privilege of sending an inspector to witness each operation in manufacturing the steel, and seven specifications are laid down governing such points as the quantity of iron used, the recarburization after the blow, pouring the metal into the moulds, and the cutting and rolling of the blooms. The results of this great care in preparing the steel are shown in the small number of barrels that fail on test. Every barrel is tested to a pressure of 70,000 pounds to the square inch in the cartridge chamber, and ten or more barrels made from each new lot of steel delivered are subjected to a special test of 100,000 pounds to the square inch. It is very rarely that a barrel fails to stand the higher pressure, which, by the way, is over two and one-half times as great as the service pressure of 38,000 pounds. It is proposed after July first next to raise the service pressure to 44,000 pounds, with a resultant velocity of 2,200 in place of 2,000 feet per second.

The blanks, which consist of pieces of round steel 1·15 inches diameter by 18 inches long, are heated to a cherry red and rolled down to size and length in special tapered rolls known as the barrel rolls. The grooves are cut with a taper as shown in Fig. 1, the rolls being geared together to insure their keeping in proper relative position. After the piece has been passed through seven times, the ends are sawn off, and it is straightened under a hammer and placed in a box of charcoal to anneal it.

The barrel is now "black straightened" preparatory to machining. There are seven straightenings of the barrel altogether, and in every case it is done by skilled workmen by the time-honored method of a hammer and an anvil. After straightening, it is centered, put in the lathe, and "spotted," that is to say, a rough cut is taken at the butt preparatory to placing it in the gun barrel drilling machine. This very ingenious machine, which is made by the Pratt & Whitney Company, is shown in detail in Fig. 7. The small end of the barrel is clamped to the head spindle and the butt is carried and rotates within the barrel support bushings, as shown. These bushings are held in a steady-rest,



7.—Drilling Bore of Barrel—Shows Exit of Oil and Chips into Oil Tank.

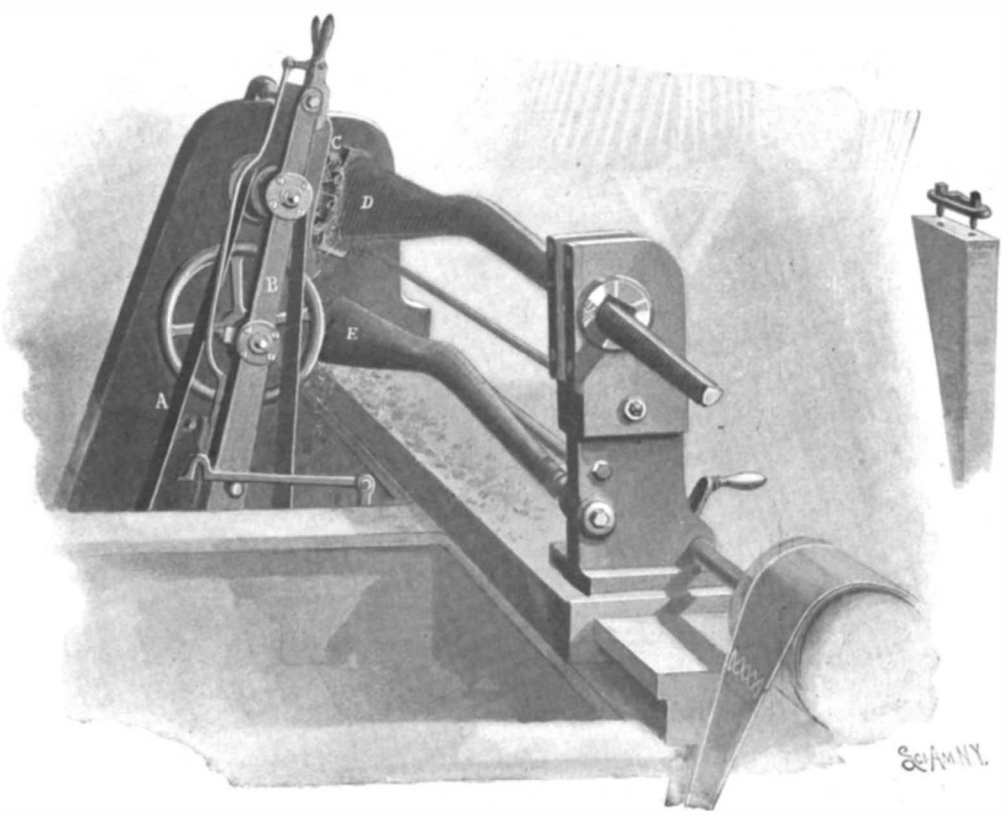


8.—Rifling Machine.

which also carries two sets of bushings which act as guides to the drill. Another function of the steady-rest is to serve as a tank to catch the oil and chips. The drill, which has to pass through 30¼ inches of barrel, is provided with a $\frac{1}{32}$-inch oil-hole which extends through its whole length, and feeds oil directly at the point of the drill. This hole, which takes the place of the old channel cut along the side of the drill, is an improvement introduced by Major Taylor. The oil is forced through the drill by means of a small rotary pump, which forms part of the machine. Although the barrel rotates at a speed of 1,200 revolutions per minute, the constant rush of cold oil to the head is sufficient to keep the drill and barrel perfectly cool, and it also serves to carry away the chips which issue in a constant stream from the rear bushing. The barrel is drilled to a diameter of 0·295 inch and it takes 75 minutes to complete the operation.

The barrels are now taken to the straightening room (Fig. 4), where the operator holds them up toward a white surface with a horizontal black line upon it and looks through the bore. If the bend is downward, the curved reflections of the black line on the surface of the bore will be convergent; if upward, they will diverges(see small diagrams to the right of the illustration). A few taps of the hammer quickly straighten the barrel until the reflected lines are perfectly true.

The bore is then given its first reaming with a square reamer of the form shown in Fig. 6, which enlarges the diameter to 0·298 inch. The barrel is next rough-turned; then straightened again and given a sec-



Rough Turning the Stock.

MANUFACTURE OF KRAG-JORGENSEN RIFLES.

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ond turning, after which it is filed down to gage. The next operation is to cut one inch of square thread on the butt of the barrel to enable it to be screwed into the receiver. After another straightening (the fourth), the barrels are chambered to a uniform diameter of $\frac{7}{16}$ inch, ready for the proof cartridge, and taken to the proving house, where they are tested to a chamber pressure of 70,000 pounds to the square inch. They are then brought back to the shops, straightened for the fifth time, and given a finish reaming to a diameter of 0·300 inch. The reamer (Fig. 6) is square in section like the tool used in the first reaming, but it is smaller in diameter than the finished bar. To bring the cutting edge in contact with the bore the reamer is packed with strips of paper, *B*, and a slip of pine, *A* (see illustration). The barrels are straightened and then placed in the polishing machine, where they are revolved and drawn up and down between oak blocks smeared with oil and emery. The barrels are first run for fifteen minutes with a combined rotary and reciprocating motion, and then the finishing polish is imparted by running them for three minutes with a simple reciprocating movement in the direction of the grain. After polishing, the barrels are given a seventh and final straightening; for there is a possibility that the friction of polishing may have heated and slightly warped them.

Next in order follows the important work of rifling. The rifling consists of four spiral grooves, which are cut diametrically opposite each other down the bore. The pitch of the rifling is one turn in 10 inches. Each groove is 4-1000 of an inch in depth, the rifling diameter being 0·308 inch. There are twenty-eight rifling machines at work. Eighteen of them are machines of an old type that have been in the shops for about forty years, and were actively engaged in rifling guns for the Federal army when the arsenal was turning out muzzle-loading rifles at the rate of one thousand a day. The other ten machines are of the new Pratt & Whitney type, shown in the accompanying illustration, Fig. 8. The butt of the barrel is screwed into the fixed head, *A*, of the machine, and the rifling rod is clamped to the traveling head, *B*. The latter is given a reciprocating rotary motion by means of a guide, *C*, which is clamped diagonally above the head at the angle corresponding to the desired pitch of the rifling. A groove in the guide, *C*, is in engagement with a transverse slide, *D*, which, by means of a rack on its under side and a pinion on the spindle, serves to give the desired rotary movement to the rifling rod. The latter is hollow and has two holes slotted through its shell to allow the cutters, *C C*, Fig. 5, to project through and bear against the bore of the gun. The cutters are forced outward by means of a tapered rod, *A*, the outer end of which strikes against a stop, *B*, Fig. 5, while the inner tapered end bears against the cutters. The rod is driven a little further in at the end of each cut, the stop being automatically advanced the required amount until the rifling is complete.

Then follows the operation known as finish chambering, which consists in reaming out the cartridge chamber at the butt. This is done by means of a reamer of the exact size and shape as the cartridge, and, as it is necessary that the cartridge should enter freely and yet fit snugly, this work has to be done with great care and checked by gages corresponding to the three diameters of the cartridge.

The barrels are finally taken to the tempering furnace, shown in Fig. 2, where about 6 inches of the butt is heated to a proper degree, and then cooled from the inside by having a stream of cold oil run through it. The furnace is gas fired, and great care has to be taken that the barrel is not heated too far up, and that it is not warped by being overheated. The object of the tempering is to give special hardness and resisting qualities to that part of the barrel which takes the force of the explosion and whose threaded end has to support the full force of the recoil. The barrel is then "browned" in the hill shops—an operation which will be described in the second article.

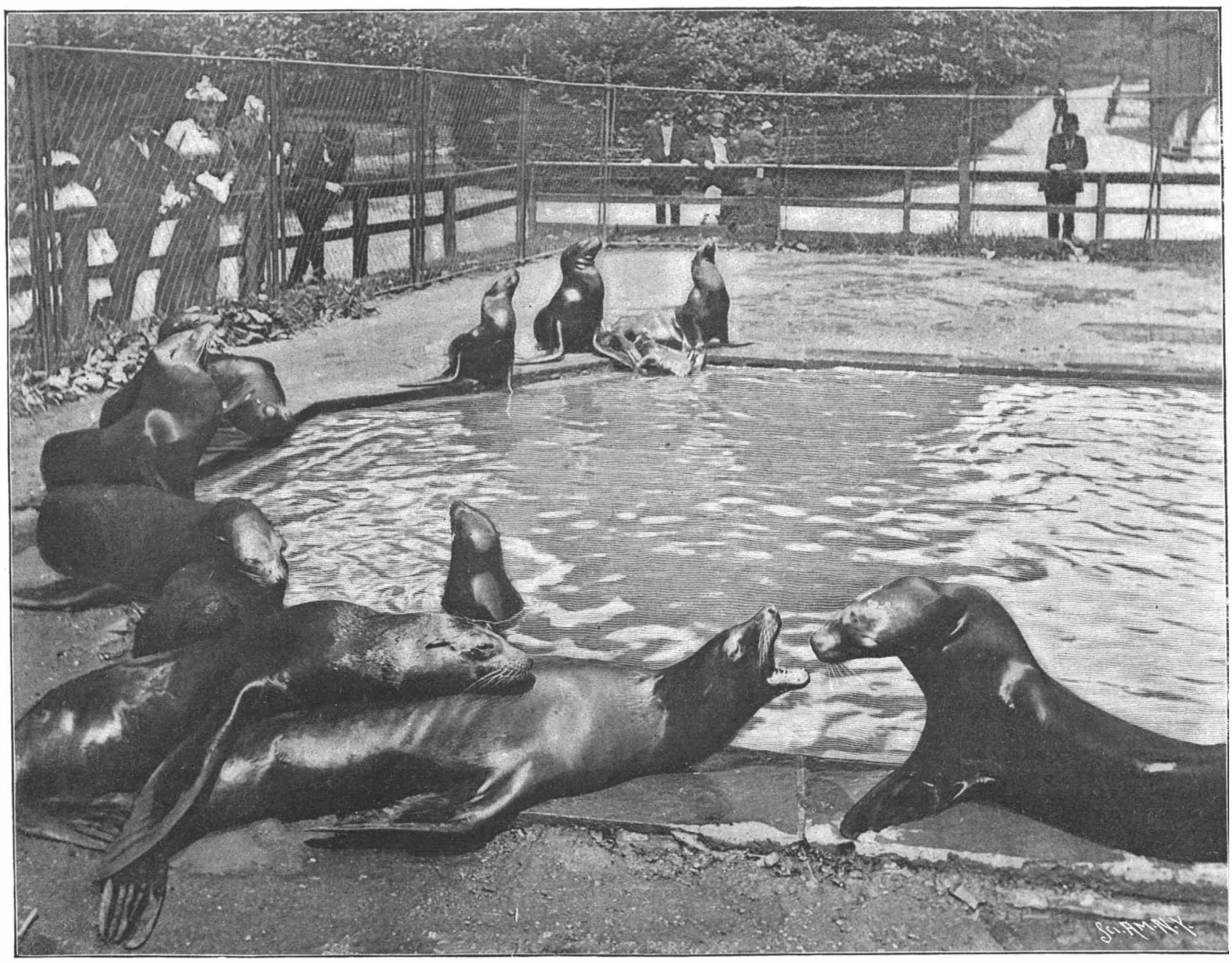
Before closing the description of the Water Shops, mention must be made of the forging room, in which are made all the forgings which enter into the complete rifle, including the bayonets. The solid forgings for the receiver are first roughed up in 800-pound drop hammers, then the approximate shape is given under a 1,400-pound drop, next it is trimmed in a press, and, finally, it is finished under a 1,200-pound drop, ready for the elaborate machining which it undergoes in the hill shops. Trigger guards, triggers, sears, and other smaller work are either roughed under drop hammers, pressed and trimmed, and finished with a single blow of the drop hammer, or they are roughed out under trip hammers and finished with a single blow of the drop hammer. Bayonets are drop-forged out of flat cast steel 0·36 × 0·88 of an inch in section, and are then milled, ground, and polished. We are informed by Major Taylor that in addition to its regular work on barrels and fittings for 400 rifles per day, this department brazed during the late war over 7,000 bayonet scabbards for 0·30 and 0·45 rifles, besides executing a large amount of special work on swords and sabers.

THE CALIFORNIAN SEA LION.

The Californian sea lion (*Zalophus Californicus*) is not restricted to the State from which it derives its name, as it is found on both sides of the North Pacific. This is a smaller species than the northern sea lion, and is readily distinguished from it by the convex crown of the head and the sudden descent of the profile at the eye. The side view at the head somewhat recalls that of the dog-faced baboons. The bristles on the side of the muzzle are very small.

The skull is remarkable for its narrowness and elongation, and also by the great development of the bony crests on the brain case. The color of this species of the sea lion is a dark chestnut brown, becoming blackest brown on the under parts and limbs. The adult male measures from 7 to 8 feet in length from the muzzle to the end of the outstretched flippers. The adult female is somewhat smaller, having not one-half the bulk of the male.

The islands on the Pacific coast are inhabited in many cases by the Californian sea lion. Captain Scammon, writing of his experiences with these animals on Santa Barbara during the sealing season of 1852, states that soon after the arrival of the party, about the end of May, the colonies of Californian sea lions began to augment and large numbers of huge males made their appearance, belching forth sharp, ugly howls and leaping out of the water or darting through it with surprising velocity, frequently diving outside the rollers, the next moment emerging from the crest of the foaming breakers and wading up the beach with head erect, or climbing some kelp-fringed rock, to doze in the scorching sunlight; while others would lie sleeping or playing among the beds of seaweed, with their heads and outstretched limbs above the surface. But a few days elapsed before a general contention with the adult males began for the mastery of the different rookeries and the victims of the bloody encounter were to be seen on all sides with torn lips or mutilated limbs and gashed sides, while now and then an unfortunate creature minus an eye would be met with. As the time for "hauling up" drew near, the island became one mass of animation. Every beach, rock, and cliff was the resting place of a sea lion, while a countless herd of



THE CALIFORNIAN SEA LION.

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old males capped the summit, and the united clamorings of the vast assemblage could be heard miles out at sea.

At the close of the season, which lasts about three months on the Californian coast, a large majority of the great herds, both male and female, return to the sea and roam in all directions in quest of food, as but few could find sustenance about the waters contiguous to the islands. They live on fish, mollusks, sea fowls, and they always swallow a few pebbles or smooth stones, some of which are a pound in weight. The quantity of fish consumed is enormous. Some years ago it was estimated that the total number of sea lions in the neighborhood of San Francisco was upward of 25,000, each of which consumed from ten to forty pounds of fish per day.

In capturing gulls the sea lion displays no little skill and cunning. When in pursuit of a gull, it dives deeply under water and swims some distance from where it disappeared, then, rising cautiously, it exposes the tip of its nose along the surface, at the same time giving it a rotary motion. The unwary bird on the wing, seeing the object near by, alights to catch it, while the sea lion at the same moment settles beneath the waves, and at one bound with extended jaws seizes its screaming prey and instantly devours it.

The California sea lion is the species usually seen in captivity in Europe and America. They appear to thrive better than any other form of seal in that state. In captivity these sea lions display great affection for one another, and when one of a pair dies the other frequently pines away and dies, according to observations made of captive specimens in Chicago. Our engraving is made from a photograph taken at Central Park, New York.

A Meteor in Russia.

According to a dispatch from St. Petersburg, a colossal meteor recently fell into the sea at the foot of Bjurbel, twenty-six miles from Helsingfors, penetrating a bed of clay for a distance of twenty-five feet. It is expected that it will be raised shortly and that the value of the iron and other elements will be very considerable.

Ocular Powers of Kaffirs and Bushmen.

It has frequently been asserted that the eyesight of Indians, Kaffirs, and "native" tribes generally is superior to that of Europeans, and Dr. Beheim, who has been on a visit to Johannesburg, has during the last few months busied himself investigating the optical condition of the natives. He has examined the sight of altogether 1,853 colored persons—Kaffirs, Basutos, Hottentots, and a few Zulus and Bushmen. The native locations and the native schools furnished most of the material. Out of 1,843 natives examined, 100 were females and 846 males, all of whom were, or seemed to be, under the age of thirty. The result, as given in The African Review, was the following:

1	had	power of sight	almost	20—60
3	"	"	about	20—50
35	"	"	"	20—40
.218	"	"	"	20—30
1,508	"	"	"	20—20
50	"	"	"	20—15
28	"	"	"	20—10
9	"	"	"	20— 5

In other words: Out of a total of 1,853 natives, 1,509 possessed a vision equal to the normal vision of Europeans, 257 had a stronger, and 87 a weaker sight than the average Caucasian.

The phenomenally powerful sight of 20—60 (which means that objects were noticed at a distance of 60 feet which an emmetropic white person could notice at 20 feet only) belongs to a Kaffir girl fourteen years old. The above-mentioned decrease of sight was due to myopia, principally acquired at school, thus proving that the same causes which produce short sight in children of the white race will react similarly in children of the dark race. Dr. Beheim found it most difficult to ascertain in every case the very exact power of vision, on account of hesitating statements; but the correct average measure has been given. The result was somewhat disappointing, in so far as the superiority of native eyesight over European is by no means so general as it is often supposed to be. With a few exceptions, all natives tested in regard to their power of vision were also tested in regard to the perception of colors; but not a single case of color-blindness, or hesitation in naming even shades of color, could be detected.

The Current Supplement.

The current SUPPLEMENT, No. 1217, is particularly interesting, and owing to the extraordinary interest concerning experiments with liquid air at the present moment, we republish an interesting article upon it. "The Logical Arrangement of the Motive Power of Warships," by Rear-Admiral George W. Melville, is an important and authoritative article on the subject. "Life Among the Crusaders," a lecture by Prof. Dana C. Munro (Professor of Mediæval History, University of Pennsylvania), is of the greatest interest and importance and is a genuine contribution to literature. This is the first of a series to be entitled the "University of Pennsylvania Lecture Course." We believe that this series will be of great importance, as the lectures are by scientists, historians, etc., of great reputation. There is also an interesting article on "Wireless Telegraphy," showing the telegraph mast and the actual instruments which are used. "How a Pope is Elected" is an exceedingly interesting article, describing in considerable detail the imposing ceremonies connected with the election of a pontiff, with fac-similes of the ballots used by the College of Cardinals in conclave.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

LAWN-MOWER.—MARTIN C. SATHER and CHARLES W. BIBB, Minneapolis, Minn. This invention is an improvement in that class of lawn-mowers having reciprocating cutter devices, and comprehends a novel construction of cutter-operating means whereby the cutter will be caused to operate uniformly on irregular as well as even ground. The knife-bar is held steadily in proper position, irrespective of the character of the ground over which it passes. The connecting means for transmitting the reciprocal action to the movable cutter-bar from the rotary drive-shaft are rendered stable and simple and of such nature as to effect a positive and uniform action of the cutter.

Bicycle-Appliances.

ADJUSTABLE HANDLE-BAR FOR BICYCLES. JESSE ALEXANDER, Manhattan, New York city. On the handle-bar a collar is fitted, having in its periphery teeth which mesh with a tooth on a plug sliding and rotating in the hollow steering-rod. A spring presses the plug toward the collar, and a locking-bar engages in a transverse slot of the plug, and with opposite slots in the steering-rod and post, to permit an adjustment of the plug. By means of this handle-bar attachment, the rider is enabled readily to adjust the handle-bar to any desired position while on the wheel.

Engineering-Improvements.

REVERSING-GEAR FOR ENGINES. — DANIEL WAITS, Rouseville, Penn. The purpose of the invention is to provide an improved reversing-gear, especially designed for use on gas-engines, and arranged to permit the reversal of the engine without undue jar to the working parts. The reversing-gear is provided with a cylinder having valved exhausts, each operated from the main driving-shaft, and with a yielding connection for the stem of the exhaust-valve to permit the exhaust-valves to be thrown to a closed position when the reversing mechanism is operated. By reason of this peculiar construction, use is made of a compressed fluid to establish an equilibrium in the cylinder to stop the momentum of the piston as soon as possible, and to start the piston on the reversing-stroke in a short time without undue shock.

Mechanical Devices.

COTTON PRESS.—EDMUND M. IVENS, 119 McCallister Street. Chattanooga, Tenn. The cotton-baling mechanism devised by this inventor compresses cotton by the roller-process. The invention provides a bat forming and laying means held to reciprocate over the press-box or bat-receiving chamber whereby the cotton is the more evenly distributed, and means so connected with the main framing of the machine as to prevent the folds or laps of the bat or sheet from expanding during the folding or box-filling operation, whereby great weight and density are obtained in a bale of small size. In connection with the lapping devices and the press-box, a plunger is used which recedes as the pressure of the folded sheet reaches a predetermined point, so as to maintain a uniform pressure on the folds.

AUTOMATIC PACKAGE-FILLER. — WILLIAM A. OVERBECK, Omaha, Neb. The present invention provides improvements in devices for automatically filling packages with sirup, oils, meal, or the like. In order that the friction of the parts may be reduced to a minimum and that greater accuracy may be obtained, the inventor employs an electromagnet and a battery for releasing the valve-closing mechanism, the magnet being operated by a contact caused by the upward swing of the scale-beam. The circuit through the operating magnet is broken as soon as the valve-closing mechanism has been released, thus using the battery as little as possible and preserving its strength.

HYDRAULIC-POWER MACHINE. — ABRAHAM L. RINEARSON, Horse Shoe Bend, Idaho. The machine is adapted to take power from the current of a stream and to apply that power for various purposes at a point inshore or over the stream, if necessary. In the construction of this machine a stationary frame is included, upon which there freely moves another frame. A current-wheel is journaled in the movable frame and drives a power-shaft supported by lift-bars. An adjusting-shaft is connected with the lift-bars, whereby the current-wheel and power-shaft are simultaneously and equally raised and lowered as required by the height of the water or by the drift.

PORTABLE BALING DEVICE. — CHARLES HEBARD, Pequaming, Mich. The device provided by this inventor is designed particularly for use in baling hemlock or other bark in the woods. The portable device comprises a frame or base which is adapted to be used as a drag or sled, and which has grooves or sockets extending along the center. A vertical compressing-frame fits in the grooves or sockets upon the base; and upon the upper part of this vertical frame compressing means are posited. Insertible in the frame are top and bottom retaining bars, adapted to receive the material between them, the upper bars being engaged by the compressing means.

MANURE-DISTRIBUTER. — JOHN M. KRAMER, FRED HECKMAN, and HENRY SYNCK, JR., of Maria Stein, Ohio. This machine is so constructed that the load of manure will be automatically fed to a distributing-beater. A retarding-beater is employed in connection with the distributing-beater, and serves to hold back any lumps of material until they have been shredded for distribution. A distributing-fork is provided which is automatically operated in conjunction with the distributing-beater, and which is so arranged that the manure may be distributed beyond the sides of the receptacle in which it is carried and beyond the ends of the distributing-beater.

SAW-SETTING MACHINE.—PIERRE SICOTTE, assignor to the Helmers Manufacturing Company, Leavenworth, Kan. It is the purpose of the present invention to provide a machine designed to set the teeth of circular and hand saws, without requiring the services of a skilled mechanic. Pivoted at one end of the frame of the machine is a saw-carrier guide carrying a swinging nut. On the guide a saw-carrier slides. An adjusting-screw engages with the nut to shift it and the carrier. When the nut is swung out of engagement with the screw, the saw-carrier can be shifted longitudinally on its guide until the saw is about in proper position relatively to its anvil. The nut is then made to re-engage the screw. The screw is next turned so as to shift the nut and the saw-carrier to adjust the saw minutely and bring the teeth in proper relation to the bevels of the anvil.

MACHINE FOR CLEANING FRUIT.—BENJAMIN B. and JAMES H. WRIGHT, Riverside, Cal. This invention is an improvement upon a machine devised by the same inventors. The improved device provides a mechanism for connecting and disconnecting the brush-supports, thereby enabling an operator quickly and accurately to substitute perfect brushes for old ones, while the machine is in operation. The backs of the brushes, moreover, are so made that the fruit will find ready entrance into the machine; and the supports for the brushes are constructed so that they may be securely and readily applied to the carrying-wheel.

Railway-Contrivances.

COUPLING FOR AIR-PIPES OF RAILWAY-CARS.—MILLARD F. SINCLAIR, Humboldt, Tenn. In the coupling a hollow-coupling-head is included, in which a spring-controlled valve is located, adapted normally to cut off the communication between the front and rear of the head. A piston is connected with the valve, which piston extends out through the front of the coupling-head. A guide is connected with the valve; and a key locks the guide. Should a train break, the valve in the coupling of the last car of the first section will automatically close, while the valve in the forward car of the detached train-section will remain open, permitting the escape of air, and thereby applying the brakes. The detached cars will thus be stopped after traveling but a short distance.

METHOD OF AND DEVICE FOR CONNECTING RAILWAY-RAILS.—CHARLES K. FREER, Port Clinton, Ohio. The abutting railway-rails are provided with diagonally-located and oppositely-inclined recesses at their end portions, the recesses in the ends of the rails being so placed that, when the rails are brought together, the outer ends of the recesses will register. A plug is located within the recesses and conforms with their combined contours. Rails thus joined cannot sag; nor can they be drawn apart unless the connecting plug be separated.

Miscellaneous Inventions.

MARKING-STAMP.—THEODORE H. SORLIEN, Granite Falls, Minn. This hand-stamp is designed for retail merchants and is arranged to mark simultaneously the cost and selling price of goods. The device consists of a stamp in which two magazines are provided, one carrying types representing the cost-mark, and the other carrying letters or figures representing the selling-price. The magazines are adjustable to permit a number of these types to be slid out and assembled in a printing-form, and there temporarily locked until the form requires to be changed.

AUTOMATIC STOOL.—CHARLES H. GREB and EUGENE B. HEID, Canal Dover, Ohio. The invention is an improvement in automatic stools of that class, wherein the arm bearing the stool at its upper end, is pivoted at its lower end in a suitable base secured to the floor. The invention provides mechanism whereby the adjustable stop for limiting the movement of the stool-arm is arranged out of the way of the mop or broom used for cleaning the floor; and the spring for actuating the arm is so incased and protected that it cannot be put under tension by the foot of a person on the stool.

MINER'S LAMP.—JOHN D. WILLIAMS, Sherodsville, Ohio. The bowl of this miner's lamp has an open end tube which is pendent from a collared aperture, and made imperforate. The cover is made independent of and detachable from the lamp-bowl upon which it fits. A pendent wick-tube is mounted within the bowl-tube and contains a wick which takes up the gasoline or other hydrocarbon used. The arrangement of parts is such as to render the lamp safe from explosion, to adapt it to be safely filled when lighted, and to increase its strength and durability.

SLATE-CLEANER.—JOHN H. WELLBORN, Agricultural College, Miss. The present invention provides a simple slate-cleaner, the water-reservoir of which is made of a single blank, bent and rolled to form a cylinder in which a cleaning-piece and a drying-piece are inserted. The body of the cleaner being filled with water, the cleaning-piece will be moistened; and the device is ready for use.

CIGAR-BOX.—WILLIAM TRIBBLE, Alton, Ill. It is the object of this invention to provide a cigar-box so arranged that the cigars may be successively drawn out by mechanical means—such, for instance, as in the coin-controlled vending-machine already patented by the inventor and described in these columns. The drawing-device is passed back and forth between the layers of cigars, with the fast end extended over the top layer. The free end passes under the lower layer and is designed to project through an opening at the bottom of the box. By pulling on the drawing-device, the cigars are discharged one at a time through the opening.

CIRCULAR SHINGLE-SAW.—SIEVE T. JOHNSON, Trinidad, Cal. The saw comprises a central section having a boss and a flange projected outwardly beyond the boss, a rim-section having teeth at its outer periphery and transverse, semicylindrical recesses in its inner periphery, and screws extending through the boss and in the recesses of the rim-section. When it is desired to remove a worn-out or broken rim-section, it is necessary to remove only the screws, and then to lift the rim-section from the boss After a new rim-section has been substituted for the old, the screws are replaced.

ELECTROTYPE. — WILLIAM T. BARNUM, New Haven, Conn. The electrotype devised by this inventor is simple in construction, and is designed greatly to reduce any strain incident to its use in the printing-press and largely to diminish the weight of the skeleton base. The printing-block has flanges constituting the body of the block and having a set of registering apertures in which strengthening-rods are fitted serving rigidly to support the flanges, one against the other.

PHOTOGRAPHIC MAGAZINE-CAMERA.—ALFRED LECHI, Manhattan, New York city. The camera contains a pile of double plate-holders which travel in grooves in the casing. A slide is movable in the casing, and has spring-hooks for moving the lowermost plate-holder from under the pile on the forward movement of the slide. The slide is also provided with bars for pushing the removed plate-holder into position for exposure on the return motion of the slide. By means of a spring operated mechanism controlled from the outside of the casing, the movements of the slide can be controlled.

INCANDESCENT MANTLE. — JOSEPH LEDERER, Manhattan, New York city. This invention provides a mantle which need not be burnt at the factory, nor impregnated when burnt in collodion in order to prevent the breaking of the delicate residue which composes the mantle. After the mantle has been impregnated with the salts usually employed, it is stiffened with a solution of collodion and camphor, and then folded to form creases. The mantle, in use, is hung from the usual burner-hook. Then by igniting the mantle, the fabric, as well as the solution of collodion and camphor, will be burnt away; and after the burner is lighted, the residue will form the usual mantle.

NECKTIE-FASTENER. — WILLIAM M. S. MILLER, Sewickley, Pa. The fastener is formed of a single piece of wire, bent to form loops which engage the collar and the collar-button. The device, when in position, is incapable of lateral dislocation, a disadvantage common to many necktie-fasteners.

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Minerals sent for examination should be distinctly marked or labeled.

(7649) P. H. W. asks: 1. What causes the report when a cannon is fired? A. The liberation of the powder gases at the muzzle of the gun. 2. Does the report obtain at the moment the projectile leaves the muzzle of gun? A. Yes. 3. Does the recoil take place before the ball is half way out of the gun? A. Recoil commences at the instant when the projectile begins to move down the bore. 4. Does the force of the powder gas exert itself up to the moment the shot leaves the muzzle? A. Yes. 5. Does the air in front of the projectile, when the gun is fired, offer much resistance to projectile when same is near the muzzle of gun? A. The air is expelled from the bore by the projectile and offers resistance during the whole travel of the projectile through the bore.

(7650) T. C. writes: In answer to query No. 7618, March 25, "Is it possible for a man to know the direction in which he is going if he were inclosed in a box with nothing except a compass?" I understand H. J. D. to mean the box to move carrying the occupant with it. If the box were placed on a car, with the occupant not knowing to which end the locomotive was attached, he could not tell in which direction he was moving, even with the aid of a compass. The compass tells or shows you the name of the direction you are moving. You must know the direction by observation. A. Query 7618 was answered with the understanding that the correspondent wished to know if a compass needle would indicate direction when inclosed in a box. This seemed to us to be the only reason for referring to the compass at all. Several other correspondents have written us, suggesting that the meaning of the question is, Can a man tell in what direction he is being carried, if he cannot see? This question requires no compass. To this question we answer, we do not know any general answer. We think some men can. We are sure others cannot.

(7651) J. B. A. writes: Please state fully through your interesting paper how scientific men determine the sun's distance. When and where were the last measurements taken? Is 92,800,000 miles the average distance, or the distance when the earth is nearest the sun? Is the above distance correct? A. One of the earlier methods for finding the solar parallax that were in any way reliable was that of Halley, by transits of Venus. From observations of the transits of Venus in 1761 and 1769 Laplace and Delambre computed the parallax or angle of the earth's diameter as seen from the sun to be 8·6″ to 8·8″, making by triangulation a distance of 95,000,000 and 92,890,000 miles. Hansen, by his researches upon the motion of the moon in 1854, corrected Enckes' computation made in 1824, making the sun's distance 91,852,000 miles. The latest discussion by Newcomb from all the previous observations, including the velocity of light as observed by Michelson, has established the solar parallax at 8·85″, which has been adopted and used in the computations for the Nautical Almanacs. It is based on Clarke's value of the earth's radius of 3963 miles, making the sun's distance 92,372,000 miles. The Paris Astronomical Conference, in 1896, adopted 8·8″ as the value of the solar parallax, and after the year 1900 this is to be used by all nations for their nautical almanac computations. It makes the sun's mean distance 92,897,000 miles. A description of the various methods that have been used for determining the parallax, which is a most interesting one, giving diagrams and formulas that we cannot produce in Notes and Queries, is contained in a chapter in Young's "General Astronomy," which we can furnish mailed at $3.

NEW BOOKS ETC.

THE PURIFICATION OF SEWAGE. A Brief Account of the Scientific Principles of Sewage Purification and their Practical Application. By Sidney Barwise, M.D. New York: D. Van Nostrand Company. 1899. Pp. i–xii., 150. Price $2.

The present volume is a small book upon a large subject, but there is no objection to this when a book is of a high technical quality like the volume before us. The chemistry of sewage, the varieties of sewage, and the changes it undergoes, as well as river pollution, rain treatment, precipitation, filtration, are all adequately treated in addition to the new departure, "bacteriolysis."

ELECTRICITY IN TOWN AND COUNTRY HOUSES. By Percy E. Scrutton. Second Edition. Westminster, London: Archibald Constable & Company. 1898. Pp. 148. Price $1.

This little book will doubtless prove valuable to those who wish to get some general information about the subject, and who do not care to go very deeply into it. The book does not call for special mention.

THE DAWN OF REASON; OR, MENTAL TRAITS IN THE LOWER ANIMALS. By James Weir, Jr., M.D. New York: The Macmillan Company. London: Macmillan & Company, Limited. 1899. Pp. 234. Price $1.25.

Dr. Weir is already known to the readers of the SCIENTIFIC AMERICAN by reason of his numerous articles of high scientific value. In "The Dawn of Reason" he deals with such subjects as "The Senses in the Lower Animals," "Conscious Determination," "Memory," "The Emotions," "Æstheticism," "Parental Affection," "Reason," and others. It is a rather difficult book to classify, but it is a very readable one, and is worthy of attention by all who are interested in any way in natural history or psychology, and shows that the author is an original thinker.

STEAM BOILER PRACTICE. In its Relation to Fuels and their Combustion and the Economic Results Obtained with Various Methods and Devices. By Walter B. Snow, S.B. First Edition, First Thousand. New York: John Wiley & Sons. London: Chapman & Hall, Limited. 1899. Pp. 297. Price $3.

There always seems to be room for a new book on steam boilers. Hardly a month goes by without one coming to the editor's table. The book before us treats of the subject in a somewhat different manner to books which have preceded it. It deals particularly with the results obtained, rather than with a detailed description of the methods and devices employed to secure the economical combustion of fuel in connection with a steam boiler. The appears to be ample room for a work which, while simple in its treatment, shall deal primarily with effect rather than with causes, and which shall undertake to indicate the possible gain or loss to result from a given arrangement and shall point toward the highest efficiency in steam boiler practice. The author has performed his task in a very creditable manner.

HARDWARE STORE BUSINESS METHODS. Compiled and Edited by R. R. Williams, Hardware Editor of The Iron Age. New York: David Williams Company. 1899. Pp. 200. Price $1.

Business nowadays has been brought to such a fine point that the merchant has actually to be taught methods of business, and no up-to-date merchant will hesitate about accepting methods which will tend to decrease his expenses or render his accounts more accurate. It would be gratifying if every kind of business should have a manual such as is now offered to those in the hardware trade. It is a book which can be confidently commended.

ENGINEERS' HANDY BOOK. Containing Facts, Formulas, Tables, and Questions on Power, its Generation, Transmission, Measurements, etc. By Stephen Roper. Revised and greatly enlarged by Edwin R. Keller and Clayton W. Pike. Philadelphia: David McKay. 1899. 16mo. Pp. 844. Profusely illustrated. Pocketbook style, full leather, gilt edges. Price $3.50.

The great value of Roper's well known pocketbook is evidenced by its being in its fifteenth edition. We have yet to learn that any poor book has reached anything like this sale. It is filled with the most valuable information, giving exactly what the engineer, and, specially, the young engineer wishes to know. Mathematics are avoided as far possible, and all of the problems in the book can be solved with the aid of arithmetic. The book is thoroughly practical, and, for this reason, it appeals to all practical men. There are a large number of questions annexed which will prove of great value to young men who are anxious to obtain engineers' licenses. The boiler, the steam engine, the steam engine indicator, gas and gasoline engines, materials, their properties and strength, are all considered. There is a discussion of experiments in electricity and an explanation of the dynamo, motor, batteries, switchboard, telephones, bells, annunciators, alarms, etc. The book is got out in very handsome form and can be carried in the pocket. It is a most admirable book.

THE A B C UNIVERSAL COMMERCIAL ELECTRIC TELEGRAPHIC CODE. Specially adapted for the use of Financiers, Merchants, Shipowners, Brokers, Agents, etc. By W. Clauson-Thue. New York: The American Code Publishing Company, 83 Nassau Street. 1899. 8vo. Pp. 480. Price $5.

A telegraphic code is absolutely indispensable in commercial transactions where the telegraph or cable is utilized, and there are a vast number of systems in use. The A B C code has an enviable reputation for being one of the most usable, and it certainly appears to be the most flexible. The present edition contains nearly 25,000 sentences, including names for products, rates, numbers, quantities, and a large number of special words which may be used by the owner of the volume for special purposes. The selection and arrangement is most admirable.

METEOROLOGICAL OBSERVATIONS. Made at the Adelaide Observatory and Other Places in South Australia and the Northern Territory during the Year 1895. Under the Direction of Charles Todd. Published by authority of the Government of South Australia. Adelaide: Printed by C. E. Bristow, Government Printer, North Terrace. 1898. Pp. 75.

THE HISTORY OF MANKIND. By Prof. Friedrich Ratzel. Translated from the Second German Edition by A. J. Butler. With Introduction by E. B. Tylor. With colored plates, maps, and illustrations. Vol. III. London: Macmillan & Company, Limited. New York: The Macmillan Company. 1898. Pp. 599. Price $4.

Prof. Ratzel is known to be one of the greatest ethnologists in the world, and his book shows a wonderful advance over its predecessors, such as Pritchard, Smith, Wood, etc. The present volume (III.) deals with the negro races in the interior of Africa and the west of Africa. Then the cultured races of the Old World are taken up, including the races of Africa and Asia, and finally the Europeans. The publishers have brought out the volume in a most sumptuous form. It is profusely illustrated, and there are eleven colored plates and several maps. The quality of the illustrationsdeserves particular mention, for too often in books of this kind the question of illustration isdisregarded, owing to the great expense, and it is satisfactory to see the life work of a great authority properly clothed. The book can be most warmly commended to all who are in any way interested in ethnology, and we regard it as one of the most remarkable contributions which have been made to the subject. We hope to give an illustrated review of this great book in our SUPPLEMENT at some future time.

A TREATISE ON PHOTOGRAPHIC OPTICS. By R. S. Cole, M.A. New York: D. Van Nostrand Company. 1899. 12mo. Pp. 330. Price $2.50.

A new work on this subject has been needed for some time, and the author has admirably acquitted himself of a difficult task. The object of the treatise is to provide an account of the principles of optics in so far as they apply to photography. The error of making it too abstruse, which would place it out of the reach of all but professional mathematicians or physicists, has been avoided. To make the mathematics as intelligible as possible, most of the results have been illustrated by worked numerical examples.

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INDEX OF INVENTIONS

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APRIL 18, 1899,

AND EACH BEARING THAT DATE.

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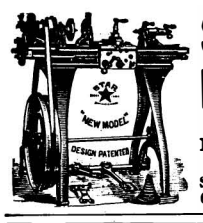

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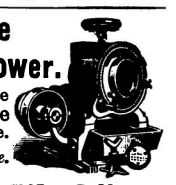

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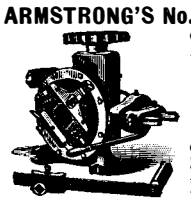

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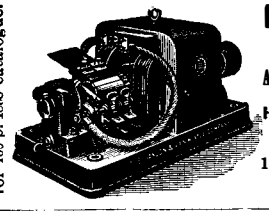

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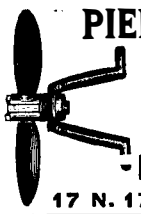

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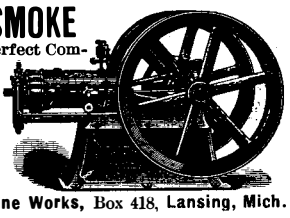

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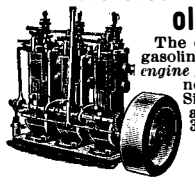

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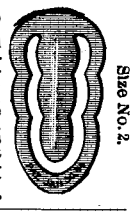

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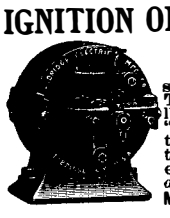

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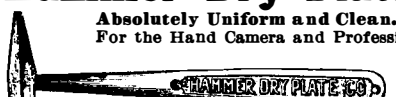

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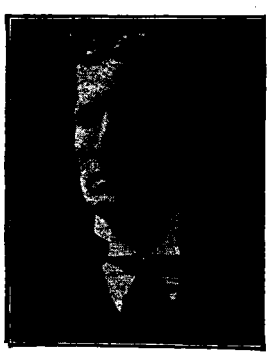

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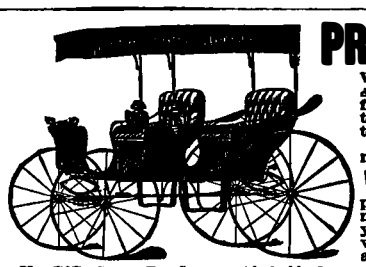

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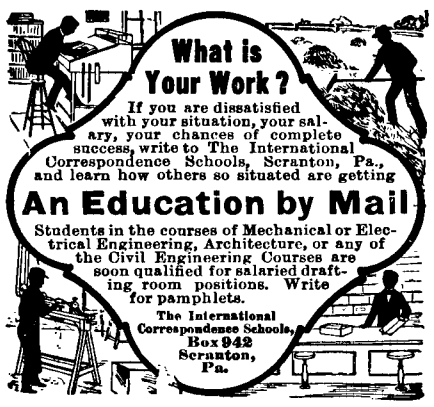
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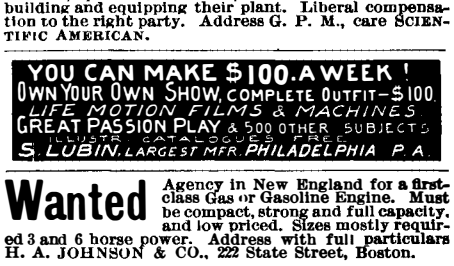

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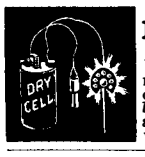

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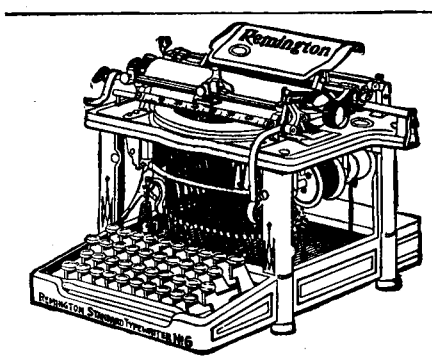

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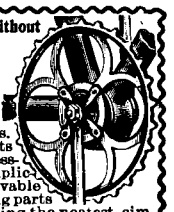

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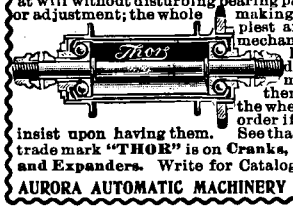

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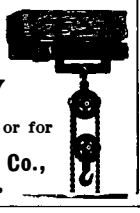

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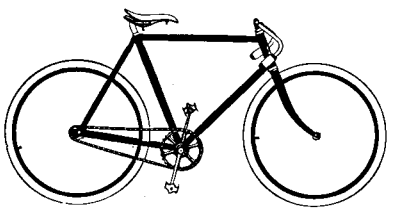

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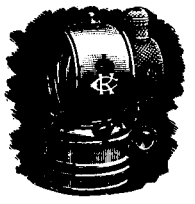

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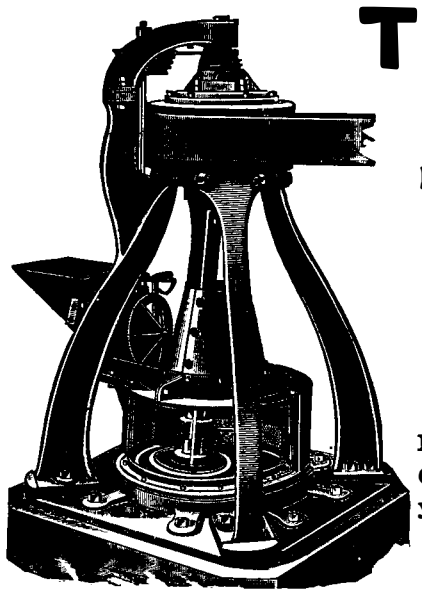

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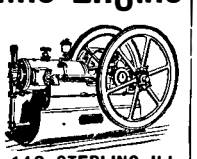

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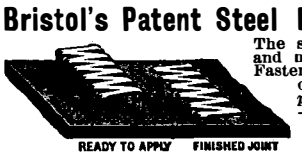

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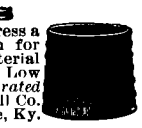

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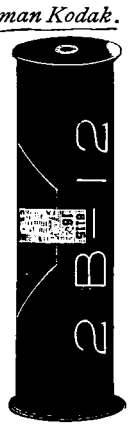

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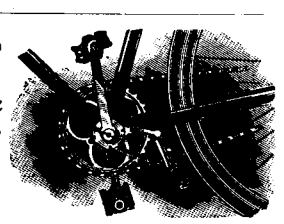

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